Designing Communication Devices for Long Distance Dating Relationships

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Publications

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Chapter 6: Device Development and Initial Design Space

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Chapter 7: Exploratory Interviews and Refined Design Space

Daniel Gooch and Leon Watts. 2012. YourGloves, hothands and hotmits: devices to hold hands at a distance. In Proceedings of the 25th annual ACM symposium on User interface software and technology (UIST '12). ACM, New York, NY, USA, pp. 157-166.

Daniel Gooch and Leon Watts. 2012. It's neat to feel the heat: how can we hold hands at a distance?. In Proceedings of the 2012 ACM annual conference extended abstracts on Human Factors in Computing Systems Extended Abstracts (CHI EA '12). ACM, New York, NY, USA, pp. 1535-1540.

Daniel Gooch and Leon Watts. 2011. A design framework for mediated personal relationship devices. In Proceedings of the 25th BCS Conference on Human-Computer Interaction (BCS-HCI '11). British Computer Society, Swindon, UK, UK, pp. 237-242.

Chapter 8: Magic Sock Drawer Pilot

Daniel Gooch and Leon Watts. 2011. The Magic Sock Drawer project. In CHI '11 Extended Abstracts on Human Factors in Computing Systems (CHI EA '11). ACM, New York, NY, USA, pp. 243-252.

Chapter 10: SleepyWhispers

Daniel Gooch and Leon Watts. 2012. sleepyWhispers: sharing goodnights within distant relationships. In Adjunct proceedings of the 25th annual ACM symposium on User interface software and technology (UIST Adjunct Proceedings '12). ACM, New York, NY, USA, pp. 61-62.

Abstract

This thesis investigates the design and use of communication technologies to support long distance dating relationships (LDDRs). We focus on using co-located behaviours that hold special relational meaning as the metaphor behind the design of devices to mediate between separated partners. Social Presence is used as the main theoretical construct through which support for LDDRs is addressed. Social Presence is a phenomenological concept which refers to "the degree of salience of the other person in the interaction and the consequent salience of the interpersonal relationship" [Short et al., 1976, p. 65]. An additional concept, Closeness, is also brought in to the design problem to account for the supportive role of communication technologies between moments of synchronous contact.

This thesis proposes three main arguments. The first is that individual acts of communication, through feelings of Social Presence, have an impact on a couple's feelings of Closeness towards one another. We explore possible connections between Social Presence and Closeness through a diary study. The results of the diary study also establish that the selection of communication media impacts feelings of Social Presence.

Our second argument is that a number of design facets, explored throughout the thesis, could enhance the design of communication technologies for LDDRs by increasing feelings of Social Presence. An analysis of current literature informs the development of seven prototype devices based on hand-holding, hugging, sharing notes and pillow talk. Two interview studies explore people's reactions to these devices. The findings from these studies are integrated into a design space which describes some of the design decisions that should be considered when creating behaviour-based devices which aim to support LDDRs.

Our third argument is that devices based on co-located behaviours support LDDRs through engendering high levels of SP. This is investigated through five case studies using the devices we previously developed, showing that three of our devices are associated with particularly high levels of SP. They also provide insights about the design space facets, as realised in the devices, through using the devices within couples' existing communication routines.

The thesis concludes with a discussion of how the results of these studies are of relevance to researchers interested in supporting long distance dating relationships. Our investigation into Social Presence provides two main contributions; firstly it offers an understanding of how various factors (including relationship type and distance) affect feelings of SP. Secondly, it demonstrates that increasing feelings of Social Presence can have a longer-term impact on LDDRs through increasing their feelings of Closeness towards one another. This suggests that SP is suitable concept to try and support through the design of communication technologies.

In addition to informing our discussion of our design space, the case studies within this thesis highlight that devices based on co-located behaviours can help support LDDRs. Given the dearth of devices based on this metaphor, we suggest that other researchers may be interested in extending these findings by exploring other behavioural metaphors.

The design space proposed within this thesis offers two main contributions. Firstly, designers can use the design space to foster innovation when creating new designs. Design spaces result in a descriptive and exploratory tool for designers creating new innovations. Secondly, the comprehensive consideration of the various dimensions, especially regarding our consideration of existing communication technologies, provides researchers with a novel design-centric view over the state of the art.

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Part I

Fundamentals of Social Presence

Chapter 1

Thesis Overview

This thesis explores how properties of communication technologies contribute to feelings of Social Presence within long distance dating relationships. Through investigating the design facets of communication technologies, several CMC devices are constructed to support long-distance dating relationships for University students. Social Presence is used as the main theoretical construct through which support for LDDRs is addressed.

Social Presence is a phenomenological concept which refers to the sense of being together, of emotional connectedness. SP is defined as "the degree of salience of the other person in the interaction and the consequent salience of the interpersonal relationship" [Short et al., 1976, p. 65], Social Presence can be thought of as the feeling of emotional connectedness experienced by a person through a single act of communication with another person.

The aim of this thesis is to explore the design of interactive technologies which engender high levels of Social Presence. As such, this thesis is based on three main areas of research:

RQ1: How should we think about Social Presence with regards to close personal relationships?

RQ2: What design facets are significant when considering the design of communication technologies for long distance dating relationships?

RQ3: Do novel designs for devices based on the design facets from RQ2 engender positive feelings of emotional connectedness?

The body of this thesis comprises 11 Chapters (including this one). We now present a brief synopsis of the remaining Chapters.

Chapter 2 reviews existing research in: (i) Relationships, (ii) Long Distance Dating Relationships and (iii) Social Presence. It explores why people form relationships and how communication is essential to maintaining those relationships. We consider Long Distance Dating Relationships, arguing that although they are inherently different from Geographically Close Dating Relationships, their use of communication technologies helps to maintain them.

Chapter 3 sets out the broad methodological position of this thesis. We explore the weaknesses of using experiments to explore questions within this area of research and set out the benefits of investigating Social Presence in contextually valid locations i.e. using field studies. We explore the various quantitative measures of Social Presence which have been proposed before selecting the Semantic Differentials measure of Social Presence to use throughout the thesis. Finally we discuss a variety of qualitative analysis techniques before settling on thematic analysis as the analysis technique used throughout this thesis. We argue that by using both qualitative and quantitative measures, we can triangulate our data, creating greater confidence in the results of our analysis.

In Chapter 4 we address the questions raised by our analysis of the Social Presence literature. Through a diary study we gather contextually valid data about people's communication behaviours and their feelings of Social Presence. By doing so we demonstrate that Social Presence is a suitable phenomenological concept to support within long-distance relationships through the design of communication technologies. We additionally demonstrate how Social Presence ratings from individual acts of communication predict feelings of Closeness experienced daily by an individual. This study addresses our first area of interest, RQ1.

Our analysis of the data demonstrates that the selection of a particular communication technology predicts feelings of SP. Our thematic analysis identified time and effort, manageability, personal connection, physicality, fleetingness and responsiveness as being important factors in people's selection of communication media within their personal relationships. This set of facets goes on to inform the creation of our initial design space, proposed in Chapter 5, developed to address our second area of interest, RQ2.

Chapter 2 analyses three sets of literature relevant to this thesis. It opens by setting out a position on communication before presenting an in-depth analysis of 32 communication devices intended to support social relationships. Methodological shortcomings are discussed in terms of the lack of evaluation of these devices. Four design facets were found to be common across these devices and are thus incorporated into the factors which go on to inform the initial design space, proposed in Chapter 5. Finally we briefly consider touch and demonstrate that haptics have previously been used to create successful devices aimed at supporting LDDRs, using the link between touch and relational intimacy.

Chapter 5 makes use of the findings from Chapters 4 and 2 to describe the design and development of seven communication devices. Each is based on co-located behaviours, aimed at supporting LDDRs through supporting high levels of Social Presence. In brief the devices are: The Magic Sock Drawer and doodleMessenger (both based on leaving love notes), hotHugs (based on hugging), hotHands, hotMits and YourGloves (based on hand-holding) and sleepyWhispers (based on late night pillow talk). These devices are the means through which we investigate RQ3.

Combined with the analysis of previous intimate communication devices from Chapter 2 we propose an initial design space of facets of communication technologies intended to map the conceptual space in which devices to support Social Presence exist. The initial design space consists of metaphor, personalisation, effort, sensory medium, fleetingness and openness.

In Chapter 6 we present two interview studies which explore people's attitudes towards the communication technologies we've developed. After introducing the design idea, participants have a hands-on demonstration of the prototype device, before finally discussing, comparing

and relating their experience with each demonstrated device to their own romantic relationship. As a result of these interviews, four further facets were added to the design space, namely synchrony, reciprocity, serendipity/anticipation and availability

We thus see a progression within the design space from an initial set of facets (Chapter 4) to an expanded set of facets (Chapter 2) to these facets being consolidated into a design space (Chapter 5) resulting finally in an expanded design space (Chapter 6).

Having laid out the design space, Chapter 9 presents a series of case studies intended to explore how people used the various devices within their own relationships and whether the communication acts which used the devices were associated with high levels of Social Presence. Chapter 7 presents a pilot study using the Magic Sock Drawer. Chapter 8 takes the findings of the pilot study and presents the methodology for the resulting case studies. This builds upon the broad methodology for this thesis discussed in Chapter 3. Chapter 9 presents the findings of the case studies involving doodleMessenger, the Magic Sock Drawer, sleepyWhispers, hotHugs and hotHands respectively. Each of these case studies involves two weeks of pre-use data collection, 4 weeks of device use and then two weeks of post-use data collection.

In Chapter 10 we collate the results of the case studies together and relate them back to RQ2 & RQ3. In terms of the design space, the case studies give us the ability to investigate how our long distance dating couples relate to the individual facets of design as embodied within the devices they used. After considering the feedback we received on the individual facets, we broadened our analysis to consider the connections between individual facets.

Regarding our third research question, our case study data indicates that devices based on the mimicry of co-located behaviours can engender a strong sense of Social Presence. We also developed a limited amount of data which suggests that the devices may have had an impact on some participant's feelings of emotional connectedness.

Finally, Chapter 11 brings together the results from the preceding 10 Chapters to identify the main conclusions of the thesis. We clarify what our main contributions are in theoretical, practical and methodological terms alongside exploring what areas of further work this thesis reveals as being interesting. We address these concerns thematically, first discussing our process of defining social presence before reflecting on the development of the devices. We then explore our design space, examining the space as a whole before reviewing four specific facets and their theoretical implications. Finally we review our methodological process, examining what aspects of it worked and which, on reflection, we would have changed.

Having presented an overview of the thesis, we now move on to review the existing research in: (i) Relationships; (ii) Long Distance Dating Relationships and (iii) Social Presence.

Chapter 2

Literature Review 1: Social Presence and Distant Relationships

2.1 Introduction

This thesis examines how long distance couples might be supported through the design of highly Socially Present communication technologies. The thesis is grounded in prior work concerning relationships, distant relationships, Social Presence, Closeness and communication.

We first consider what relationships consist of in terms of the formation and maintenance of social bonds. We then move on to discuss Long Distance Dating Relationships (LDDRs) and how they differ from Geographically Closed Dating Relationships (GCDRs). We establish that LDDRs are not inherently weaker than GCDRs and discuss how the typical communication routine of an LDDR helps to sustain the relationship. We then consider the concept of Social Presence and it's basis in prior research on communication technologies. We argue that we can support Social Presence within LDDRs by designing communication technologies specifically for that user group. We then consider how Social Presence relates to another relational concept, Closeness, in order to assess the likelihood that increased Social Presence has a relational impact beyond specific acts of communication.

2.2 Relationships

"What makes us human is not our bodies but our minds" [Dunbar, 2003a, p. 163]. One of the defining characteristic of the human race is our ability to think. Some cognitive evolutionary theorists have argued that humans have an unusually large brain for our body size compared with other species. One theory as to the purpose of this over-large brain is that a larger brain helps us to deal with living in large social groups. Given the cost of maintaining a larger brain, evolution dictates that we would not maintain large social groupings without them having intrinsic advantages over smaller groups. This suggests that group size drives brain size

evolution rather than brain size driving group size [Dunbar, 2003a, 1998]. This theory suggests that there is an evolutionary argument that relationships are key to being human.

This is not to suggest that our brain is the most important aspect of our relationships. The human body is equally, if not more, important to understanding our relationships. Merleau-Ponty argued that our physical form is the manner in which we learn about the world as the human body is an entity like every other entity in the world [Merleau-Ponty, 1967, Abram, 1997]. Our bodies and the way in which we experience everything, the mechanism with which we can interact with other people and objects. We discuss the importance of the human body further when considering the power of embodied interaction (see Section 2.11.1) and how designing technologies based on the mimicry of physical behaviours, such as hugging, can create intense personal connections (see Chapter 6).

Huijnen et al. [2004] discussed categorising groups as primary or secondary, where "primary groups are small, close-knit groups such as families, friendship cliques, children's playgroups, emotionally close peers, and neighbourhoods. Secondary groups, on the other hand, are larger and more formally organised and tend to be shorter in duration and less emotionally involving than primary groups" [Huijnen et al., 2004, p. 41]. The important point is that the grouping of contacts implies that there is some difference between different types of relationships.

The determination of which relationship is in which group comes down to two main factors; frequency of contact and the intimacy of the relationship. This is why the categorisation of contacts is of interest. Work investigating novel communication technology has found similar results, reporting that "most participants have a select group of people that they feel they should always be available for" [Chen et al., 2006, p. 371].

Frequency of contact is determined by active factors (genetically related, emotional closeness) but also by passive factors such as distance; the "time since last contact increases as distance to the individual increases, decreases as emotional closeness increases" [Dunbar, 2003b, p. 59]. Questionnaires detailing who an individual contacts every month have shown that the number of contacts were fairly stable; what changed was the number of non-kin who were contacted which was predicted by the number of kin an individual has [Dunbar and Spoors, 1995]. Given that we are primarily interested in spatially separated relationships, this provides some initial evidence that distance does have a significant impact upon people's relationships and communication habits.

The link between frequency of contact and relationships has been made by others. An analysis of the data gathered by the 2004 Survey of Health, Ageing and Retirement in Europe concludes that there is a negative association between greater geographic distance and frequency of contact, though this is variable across cultures [Hank, 2007]. Fehr argues that "day-to-day contact is conducive to the formation of friendships" [Fehr, 2000, p. 71] and that people report more positive feelings the more frequently they interact with someone. These positive feelings are important as they help to create an intimate emotional bond between the interlocutors, sustaining their personal relationship. Conversely, "the loss of proximity is associated with friendship termination" [Fehr, 2000, p. 79]. The low level of intimacy between casual friends is not sufficient to maintain the relationship over a distance.

2.3 Long Distance Dating Relationships

We have just argued that distance has a significant impact on people's relationships. The aim of this thesis is to develop an understanding of how to support long distance dating relationships through the design of communication technologies. In order to do so, we need to first discuss what is known about Long Distance Dating Relationships (LDDRs). An excellent discussion of this area of research can be found in [Stafford, 2005]. Throughout this thesis the terms 'distant relationship' or 'long distance couple' both refer to LDDRs rather than any other relational type.

Relationships may suffer through periods of separation for numerous reasons including military deployment, career opportunities and education. Estimates have suggested that between 25% to 50% of students will be in an LDDR at any given time, with up to 75% of college students being involved in an LDDR at some point [Dellmann-Jenkins et al., 1994]. Estimates have suggested that up to one million people annually belong to a long-distance relationship [Maines, 1993] and LDDRs have been reported as being as prevalent on college campuses as geographically close dating relationships [Stafford et al., 2006]. Regardless of the exact numbers or proportions of people in LDDRs, it is clear that there are a large number of people living away from the person they love.

There is a cultural assumption that Face to Face contact is necessary for forming and maintaining close relational ties and that geographic proximity is necessary for close relationships [Stafford, 2005]. Similar concerns exist between co-located and distant friendships [Becker et al., 2009]. "A majority of both lay people and researchers believe that long-distance relationships (LDRs) usually fail" [Guldner and Swensen, 1995, p. 314]. In addition to cultural assumptions, researchers have argued that LDDRs are "fraught with uncertainty and ambiguity" [Lydon et al., 1997, p. 105]. 66% of college students believe that LDDRs will not endure [Helgeson, 1994]. Stafford et al. [2006] found that around half of LDDRs broke up whilst still long distance. This is perhaps unsurprising given the length of time that relationships can be maintained at a distance. Other work has suggested that long distance partners experience difficulties in meeting each other's relational needs (specifically intimacy, sexual, companionship, security and emotional needs) [Le and Agnew, 2001], though social and cultural dislocation could introduce different relational needs for LDDRs.

Viewing LDDRs as being weak is not groundless; geographical separation is a time when some students end romantic relationships [Hill et al., 1976] and living too far apart has been reported as a reason for relationship termination even if the researchers found no such significant difference between LDDRs and GCDRs [Van Horn et al., 1997].

Although we acknowledge that LDDRs may have some weaknesses, there is a substantial body of evidence which argues that LDDRs can be as successful as GCDRs. Work has found no significant difference in satisfaction between GCDRs and LDDRs [Dellmann-Jenkins et al., 1994, Van Horn et al., 1997]. Guldner and Swensen [1995] found that relationship satisfaction, intimacy, trust and commitment are not significantly different between LDDRs and GCDRs. LDDRs have also been associated with positive relational traits such as a greater belief that their relationship will work out in the long term [Van Horn et al., 1997] or that they will marry at some point in the future [Stafford et al., 2006, Stafford and Reske, 1990] compared to GCDRs. Dellmann-Jenkins et al. [1994] found no significant difference in feelings of intimacy between

LDDRs and GCDRs using the Personal Assessment of Intimacy in Relationships (PAIR) measure. They go on to argue that as LDDRs recorded less face to face communication, intimacy must be created through other communication technologies.

LDDRs have many positive facets which are missed when the couple become geographically close. These include the amount of autonomy an individual has within an LDDR, the freedom to allocate their own time to the activities that the individual wants to undertake and the excitement and sense of specialness an individual has of being in an LDDR. This transition from living at a distance to living nearby caused a third of couples to terminate within 3 months of their reunion [Stafford et al., 2006]. Two main reasons were given for these breakups; the first was that people missed the anticipation of seeing the other person and found it hard to adjust their day-to-day behaviour. The second reason was based on idealisation (which we discuss in greater depth shortly) which meant that partners had to adjust their learning and understanding of the other person. Sahlstein [2004] argues that being distant is neither a positive nor negative experience but that it has elements of both. For example, being apart makes the couple want to have a good time while together whilst being apart also allows partners to get work done. Distance is simply something which presents special challenges for managing availability, especially with regards to developing new communication habits and routines, and personal understanding.

2.3.1 Communication in LDDRs

Previous research has considered what 'success' means within the context of relationships (see [Stafford, 2005] for a summary). Relationship survival is not necessarily the most appropriate indicator of relational success as some relationships should end as they are not appropriate for the people in it. Considerations of 'success' are not key to this thesis: our focus is on the design of communication technologies with high levels of Social Presence. We are concerned with supporting the relationship, assuming that feelings of Social Presence are integral to the maintenance, rather than the 'success', of the relationship. It is generally accepted that "relationships are both based in mutual interactions and go beyond interactions" although other factors, such as kinship, are also used to define them [Stafford, 2005, p. 6]. This highlights the importance of communication in the description of relationships. That said, relationships do not end simply because the couple are not interacting at that moment in time. Regardless, it is significant as we should consider any differences in communication behaviour between LDDRs and GCDRs.

We are not focussed on the detailed theoretical approaches to relational maintenance (see [Stafford, 2005, Canary et al., 1993, Pistole et al., 2010]). These are behaviours that people perform to maintain their relationship the way they want it. Canary et al. [1993] demonstrated that these strategies differ between different relationship types. All involve communication to some extent, especially those strategies which focus on meaning as a form of relational maintenance. In particular, Duck has argued that mundane face to face conversation is integral to maintaining romantic ties (e.g. [Duck and Pittman, 1994]) and that relationships are contingent on shared meaning ([Duck, 1994]). Pistole et al. [2010] found that although LDDRs have unique stressors (such as expense of travel and relational disruption of travel) they do not suffer day-to-day relational stressors due to the distance between partners. Our focus is at a higher level; how can we design technologies to support relationally meaningful communication

in terms of the feelings experienced and expressed in the interaction.

Some work has argued that there is an association between face to face communication and relational success. Holt and Stone [1988] reported that college partners who saw one another less than once a month (and were 250 miles apart) were less satisfied than couples who saw one another more frequently. Dainton and Aylor [2002] asked participants how often they saw their partner. Those who answered "never" were less satisfied than those who had regular face to face contact. These findings are limited as the phrasing of the question appeared to operate over a single week rather than a longer period. The question phrase is not listed but focusses around "how often, during a typical week, they communicated via different communication channels". This means that a number of participants may have been placed in the 'never' category inaccurately.

Based on interview data, Arditti and Kauffman [2004] report that communication was essential to the maintenance of distance relationships for students aged 23-35. Distance didn't affect how well the participants believed they knew their partner. Part of the reason that distant relationships remained strong was based on the belief that the relational distance was only temporary and would end at the end of their educational period. This is of great relevance to this thesis, given the focus on students where their separation period is believed to be of a fixed length. Similar claims have been made by other researchers (e.g. [Hess, 2002]).

Taking mediated communication, Dimmick et al. [2000] demonstrated that the telephone provided more social gratifications (such as emotional expression) than email. This work is of limited interest to us as participants were neither students nor did it focus only upon dating relationships. Additionally the data is based around generalised opinions of communication use rather than attitudes tied to on actual use. It is unclear how valid such data may be in the context of romantic interactions. However, it does indicate that different media satisfy different needs.

Dainton and Aylor [2002] found that different technologies were associated with different levels of relational success (telephone time and internet use being positive indicators of increased satisfaction). The classification of media is somewhat crude – the 'internet' could contain email use, IM messages, newsgroups or video conferencing. This means the in-depth analysis is somewhat meaningless even if it indicates that different communication technologies are associated with relational success.

LDDRs have less opportunities for face to face communication than GCDRs but no more opportunities for mediated communication [Stafford and Merolla, 2007]. In order to maintain their relationships, individuals in LDDRs were found to characterise their everyday talk as more intimate in focus than GCDRs [Stafford, 2010]. It could be that people in LDDRs are prepared to invest more effort and significance in their mediated exchanges than people in GCDRs. This could account for the fact that LDDRs perceived their communication to be of a higher quality than GCDRs [Stafford and Merolla, 2007]. Similar findings were reported by Mietzner and Lin [2005]. They reported that LDDRs stated that they had 'better communication' than GCDRs without going into the details of what that exactly means. The interpretation of their results go beyond the data they collected; the selected quotations are not as expressive as the analysis would suggest. Importantly, they do argue that the lack of physical intimacy is a significant negative facet of distance relationships

More restricted communication has been found to lead to more idealisation [Stafford and Reske,

1990, Stafford and Merolla, 2007, Pistole et al., 2010]. Idealisation is the phenomenon whereby people perceive something to be better than the evidence would suggest, focussing on positive attributes and ignoring negative ones. In a relational context, idealisation often includes focussing on a partner's positive traits whilst ignoring those traits which damage the relationship. Dainton and Aylor [2002] propose a related argument, that LDDRs who have frequent short face to face visits may be on their "best behaviour" allowing idealization to continue despite spending time together.

Idealisation may help to explain the side-effect that upon reunion, LDDRs are more likely to separate [Stafford and Merolla, 2007]. Other researchers have presented data which indicates that moving apart after being together is just as challenging (e.g. [Sahlstein, 2004]).

As we are interested in the design of communication technologies, it is necessary to note that "there is a possibility that increased interaction may result in increased knowledge and thus relational demise" [Stafford, 2005]. Increased interaction may undermine idealization, destroying the relational bond. It is arguable as to whether this is good or bad. Our view is that idealisation is one factor amongst many which can have an impact on LDDRs; and that it has no specific role in informing this thesis.

To briefly summarise this work, we have established that communication technologies are important to LDDRs and that the design of these technologies can have an impact upon the relationship.

2.3.2 Methodological approaches to LDDRs

Beyond this summary, there are some methodological points to draw from this body of work. The majority of studies (e.g. [Stafford et al., 2006, Dellmann-Jenkins et al., 1994, Guldner and Swensen, 1995, Van Horn et al., 1997, Hill et al., 1976, Stafford and Reske, 1990, Dainton and Aylor, 2001, Stafford and Merolla, 2007]) use students as their target population. The reason for this is that not only are students an accessible population, they are also a population who have a high number of distance relationships. We similarly intend to scope this thesis to focus on students in LDDRs but to contextualise this focus by including other populations of interest (e.g. parents who live away from their children).

Many studies focus upon individuals rather than couples (e.g. [Stafford et al., 2006, Dellmann-Jenkins et al., 1994, Le and Agnew, 2001, Guldner and Swensen, 1995, Stafford and Reske, 1990, Stafford, 2010, Arditti and Kauffman, 2004]). The reason for this is that many relational concepts (e.g. Closeness, Social Presence, Intimacy, Relational Satisfaction) operate on an individual level – different members of the couple may feel differently about the relationship or communication acts. We intend to follow this approach.

Defining what an LDDR is compared to a GCDR is somewhat contentious. 'Miles apart' has been used by some researchers but using a participant's own understanding captures each individual's relational reality better than researcher-imposed constructions [Dellmann-Jenkins et al., 1994]. Two members of the same couple have been found to disagree as to whether their relationship is long-distance or not [Stafford, 2005]. For this reason, many people now use the definition of long distance as meaning that "you are separated from your partner by a physical distance that prevents you from seeing each other every day, if you wanted to" (e.g. [Stafford

et al., 2006, Van Horn et al., 1997, Guldner and Swensen, 1995, Dainton and Aylor, 2002, 2001, Pistole et al., 2010]). Again we intend to follow this approach.

Some work has imposed a minimal length of relationship needed before the couple were considered valid to study. Six months is commonly used for this purpose (e.g. [Dellmann-Jenkins et al., 1994, Arditti and Kauffman, 2004]). The reason for limiting participation to couples who have been together for a minimum length of time is that the couple will have finishing forming and will have developed a minimal sense of a communication routine. We will thus apply the same scoping rule across this thesis and only involve participants who have been together for at least six months, people who are in an 'established' relationship.

In methodological terms, questionnaires are frequently used to assess attitudes and feelings (e.g. [Stafford et al., 2006, Dellmann-Jenkins et al., 1994, Guldner and Swensen, 1995, Van Horn et al., 1997, Hill et al., 1976, Stafford and Reske, 1990, Dainton and Aylor, 2001, Pistole et al., 2010]). Diary studies (e.g. [Le and Agnew, 2001]) and interviews (e.g. [Arditti and Kauffman, 2004]) are much rarer. Although questionnaires are suitable for some concepts (such as relational satisfaction) which are relatively stable, they are less appropriate for assessing concepts which fluctuate, such as feelings of Social Presence as addressed in this thesis (see Sections 2.4 and 2.5). Given that Social Presence fluctuates as a function of specific acts of communication, we intend to use diary studies to consider the volatile nature of SP and interviews to consider the broader aspects of relational support, suited as they are to probe deeper into the relative area of interest. Section 3.1 contains more details on the strengths and weaknesses of diary studies.

Interviews, questionnaires and diaries all produce self-report data, the advantage of which is that the data is gathered directly from the people who are experiencing the phenomenon. However there are a number of disadvantages which apply across the various self-report methods. These disadvantages include:

- People may not be able to provide the level of detail that the researcher requires
- People may deceive themselves or others
- People may bias their opinions to conform with others or what they think the researcher expects from them
- Self-report systems do not provide a truly random sample
- There are consistency issues with the data, particularly related to primacy and recency effects

As we go on to discuss in Section 3.4.2, we use a number of techniques to ensure that our studies provide an adequate level of reliability and validity.

There are some limitations in this area of research which have previously been acknowledged (see [Stafford, 2005]). Much of the work in this area focusses on young, white, middle-class heterosexual couples and does not consider cross-national relationships. Our work does not correct for these limitations – the bias of using University students (for the reasons we've discussed) tends to introduce these limitations through the typical population of a UK University.

Although we have been discussing distance and its impact on relationships, there is a factor we have yet to mention: time. "The immediacy of modern communication technologies... highlights one specific factor in long-distance family communication – the time difference" [Cao et al., 2010, p. 155]. Having questioned a number of family members living in different time zones, Cao found that despite the difficulty posed by time differences, synchronous methods dominated communication amongst family members. Schedules were an issue, with misalignment of daily schedules being a common problem especially as people were not willing to adjust their own schedule except for special occasions. Unsurprisingly, "people who communicated with their original time zone were generally more effective with the conversion than those (especially parents) who remained in the native time zone" [Cao et al., 2010, p. 157]. Cao has demonstrated that these relationships have specific needs and requirements, especially regarding scheduling synchronous communication within both interlocutor's routine, which although relevant to people within LDDRs, are less significant to people who live within the same time zone. Although LDDRs can exist across time zones, we have decided to scope these relationships as being out of interest for this thesis.

Having discussed LDDRs, we now turn our attention to the concept through which we want to support distant relationships – Social Presence.

2.4 What is Social Presence?

There are two broad categories of how spatially separated or distributed people can feel to be in the presence of the other. The first is physical presence, the sense of being bodily located together, despite being in a remote physical space [Turner and Turner, 2004a, 2006, 2004b]. The second, Social Presence, relates to a sense of togetherness, of emotional connectedness [Howard et al., 2006, Baren and Lanen, 2003], of social interaction with a distant partner [IJsselsteihn et al., 2001]. At the cross section of these two categories "we can identify *co-presence* or a sense of being together in a shared space, combining significant characteristics of both physical and Social Presence" [Ijsselsteijn and Riva, 2003]. A review of the various types of presence can be found in [Schultze, 2010]. Although interrelated, the concepts are distinct; it is possible to conceive of situations where people feel emotionally but not physically present (e.g. exchanging MMS messages) and not emotionally but physically connected (e.g. exploring Second Life with a set of strangers).

By reviewing several relevant literatures, Lombard and Ditton identified six different conceptualisations of presence: realism, immersion, transportation, social richness, social actor within medium and medium as social actor [Lombard and Ditton, 1997]. Based on these conceptualisations, they provide a unifying definition of presence as the "perceptual illusion of non-mediation". Although a unified definition can be useful, especially as it accentuates the common elements of the different conceptualisations, it remains clear than "social and physical presences are distinct categories that can (and should) be meaningfully distinguished" [Ijsselsteijn and Riva, 2003].

> "The obvious difference [between the conceptualisations] is that of *communication* which is central to social presence but unnecessary to establish a sense of physical presence. Indeed, a medium can provide a high degree of physical presence without

> having the capacity for transmitting reciprocal communication signals at all. Conversely, one can experience a certain amount of Social Presence, or the 'nearness' of communication partners, using applications that supply only a minimal physical representation, as is the case, for example, with telephone or internet chatrooms." [Ijsselsteijn and Riva, 2003]

Our focus is on Social Presence (SP). This thesis argues that designing communication technologies which engender a strong sense of SP could help support Long Distance Dating Relationships. We are not interested in the mental processes and neural correlates which make Social Presence possible [IJsselsteihn, 2002]. We are interested in Social Presence as it encompasses an understanding of how individual acts of communication can have an impact on how people think about the person they are communicating with.

Social Presence has been referred to in many ways – presence-in-absence, emotional closeness and intimate communication are all phrases which refer to SP. It has also been defined as including the sense of "being together" [de Greef and IJsselsteijn, 2000a], the sense of "being there with others" [Schroeder, 2002] or more generically as the "perceptual illusion of non-mediation" [Lombard and Ditton, 1997].

Using several terms for the same concept has three negative implications. The first is that when using such terms, without clarifying them at length, it is hard to know exactly what is being discussed. The second is that evaluation, and comparing results, becomes much harder as the specific concepts are not known. Finally, from an academic perspective, collecting and collating work completed in the area is very difficult as the terms are used interchangeably and at the same time, to mean different things. For example, social connectedness has been used as a similar yet distinct concept [van Bel et al., 2009].

The concept of Social Presence originates from the work of Short et al. [1976] who distilled the findings of a five year programme on how communication between people is affected by the choice of communication medium. One of the derived concepts was Social Presence which is defined as "the degree of salience of the other person in the interaction and the consequent salience of the interpersonal relationship" [Short et al., 1976, p. 65]. That is, it is a temporary belief or attitude induced in the mind of one party as they interact with another about their relationship with that other party. The mechanisms at work to induce relational attitudes are complex but the media through which the interactions take place certainly have a role to play.

The Short et al. definition has a drawback; it has often been used in conjunction with the claim that the level of Social Presence is an inherent quality of the communication medium and dependent upon nothing else. Given the focus on improved technologies for tele-presence, it is unsurprising that a similar position existed for Social Presence [Ijsselsteijn and Riva, 2003]. It is also easier to change communication technologies than social processes which led to the medium being emphasised over any other factor.

The SP-is-in-the-medium idea was consistent with Daft and Lengels Media Richness Theory whereby richer media, utilising more cues, permits more opportunity for creating a sense of Social Presence [Daft and Lengel, 1986]. However, this generalized 'sum of cues' view cannot adequately account for relational phenomena such as hyperpersonal communication [Walther and Burgoon, 1992, Walther, 1996]. As both the range of CMC opportunities have expanded and the degree to which technologies have become embedded in situations outside of work, so

the relational significance of the communication media has become ever more exposed. Viewing Social Presence as being entirely in the medium, and rejecting Media Richness Theory, Walther proposed his own theory, that of Social Information Processing (SIP). This theory argues that CMC technologies can create as close a relationship as face-to-face communication. Although mediated communication tends to have fewer cues than face-to-face communication, given sufficient time Walther argued that mediated relationships may demonstrate the same relational dimensions and traits as face-to-face relationships [Walther, 1992]. Mediated communication has four facets which can assist in building this level of intimacy. Firstly, message senders can choose to be selective in the cues that the communicate, resulting in optimised self presentation. In other words, message senders can opt to create a more favourable impression through being more selective in the cues they communicate than is possible in face-to-face communication. Secondly, given the reduced number of cues, receivers are more likely to idealise their partner. Thirdly, some CMC technologies are asynchronous meaning that people have the time and opportunity to craft their messages such that they fulfil their relational needs. Finally, there is a possibility that the feedback loop of CMC can create a self-fulfilling prophecy. This can assist in creating hyperpersonal relationships if the interlocutors first form positive impressions of one another [Walther, 1996].

The SIP theory is limited by the fact that it suggests that the design of the communication technology is relatively unimportant given sufficient time to develop the relationship. A similar debate around communication bandwidth finds some researchers (e.g. [McGrath, 1990]) arguing that the number of cues within a technology has a direct impact on the emotional experience of using that technology with others arguing that other factors also have an impact (e.g. [Hauber et al., 2006, Brown et al., 2009, Baharin et al., 2008]). We agree that there appears to be no direct link between the bandwidth of a communication technology and experiences of Social Presence. Given that SIP was only proposed to overcome the shortcomings of Media Richness Theory, we must now discuss the evidence which indicates that Social Presence is not determined purely by the communication media used. For a greater review of CMC theory in more detail, see [Whittaker, 2003].

We argue that Social Presence also involves "the way individuals perceive their discussions, and their relationships to the persons with whom they are communicating" [Short et al., 1976, p. 65]. These are ideas which were acknowledged as being significant in the original work but have sometimes been disregarded in favour of emphasising the quality of the medium concept.

Our understanding of SP has developed as it has moved away from focussing exclusively on the medium to become a psychological construct that reflects the subjective experience of closeness to and connectedness with others in mediated communication [Biocca, 1997]. This fits with the broader concept of Presence which, it has been argued, uses two general categories which determine a user's presence: (i) media characteristics (such as synchrony) and (ii) user characteristics (such as gender, age, traits and experience) [Ijsselsteijn and Riva, 2003].

The original discussion of Social Presence states why it is not composed off a simple sum-of-cues:

> "There is no compelling reason why removal of cues at the level of the mechanics of the interaction should always lead to a reduction in the overall efficiency. The cues removed might have been distracting and their removal might serve to concentrate attention on the important aspects of the interaction, thus making the overall outcome more efficient." [Short et al., 1976, p. 62].

Other researchers have argued against the Media Richness Theory. For example, Hauber argues that "if communication channels are missing, speakers automatically compensate for their absence through a more extensive use of supported channels (mostly verbal) in order to adhere to the grounding mechanisms that can be used in non-mediated communication" [Hauber et al., 2006, p. 414]. This argument is realised in everyday experience of using emoticons in text-based communication to provide some sense of emotion. Furthermore, a perceived need to make certain information explicit could create better conditions for eliminating ambiguity.

The confusion over defining and scoping Social Presence could be an entire thesis by itself. We take the view that "Social Presence cannot really be conceptualized as a fixed property of medium. Rather it is best conceptualized as a property of individual perceptions of mediated others, that likely fluctuates during interactions, tasks, and individual differences" [Int, 2002, p. 30]. This view of SP has been proposed by other researchers (e.g. [Lombard and Ditton, 1997]). In other words, Social Presence is a property of acts of communication, affected by the communication media being used alongside other factors.

None of the work which we have discussed here has systematically considered what the connection is between relationship distance or the type of relationship and feelings of Social Presence. Do co-located couples experience higher levels of SP than their distant counterparts? There is an opportunity to examine this connection and establish the importance of SP within LDDRs. We return to this issue at the end of this Section.

Communication is key to supporting relationships; indeed some people would argue that without communication there is no relationship. "The terms *communication* and *relationship* are inextricably linked. Existing research and theory indicate that communication creates and sustains relationships and, as well, that relationships shape both the enactment and interpretation of communication" [Sillars and Vangelisti, 2006, p. 345]. As Social Presence is an inherently relational concept, and tied in with properties of communication media, it allows us to examine change on relationships through the design of communication technologies.

We should make clear that our interest is not in understanding the aspects of individuals which predict feelings of SP. Concepts such as empathy ([Baron-Cohen and Wheelwright, 2004, Cramer, 2003, Preece and Ghozati, 2001, Mehrabian and Epstein, 1972, Baron-Cohen, 2003, Davis and Oathout, 1987, Hall, 1978]) and emotional awareness ([Picard, 1997, Brave and Nass, 2003, Neese, 1990, Ekman, 1994, Averill, 1980, Shweder, 1994, Öhman et al., 2001]) are likely to be associated with the experience of SP in some way. Defined as "a complex psychological inference in which observation, memory, knowledge and reasoning are combined to yield insights into the thoughts and feelings of others" [Preece and Ghozati, 2001], it is possible to see the potential relationship between intimacy and SP. Our research does not intend to explore such relationships as it focusses on the ability of communication technologies to mediate experiences of SP. We return to discuss this issue in Chapter 11 which discusses further work.

There is a small amount of evidence that there is a sex difference with regards to SP, with women reporting higher feelings of SP (see [de Greef and IJsselsteijn, 2000a] and what appears to be a similar account of the same experiment [De Greef and Ijsselsteijn, 2001]). We will not pursue this as we are more interested in the design of communication technology to support relationships in a gender neutral manner. Without a large amount of evidence, this would have been an interesting but divergent line of investigation.

"Communication technologies in all their forms (including letters, telephony and the internet)

aid in bridging the gulf between physical absence and social presence" [Howard et al., 2006, p. 909]. Having discussed the definition of Social Presence, and how the concept relates to other concepts within the field, we now turn our attention to discussing how communication technologies can impact on feelings of Social Presence.

2.4.1 Factors affecting feelings of Social Presence

Hauber et al. [2006] found that differences in spatiality in video conferencing led to differences in the level of Social Presence. As the medium was not changed, only its use, this is indicative that how the medium is used is significant, along with the choice of medium. Although there is an issue with regards to the results presented – there was a lack of experience and training that would affect some of the systems – this does not appear to have a significant impact upon the study as a whole given that the lack of experience refers to the medium as a whole rather that it's use. Bradner and Mark [2001] present related work as their findings indicate that a low-bandwidth connection, such as application sharing, can communicate the presence of another person. This was achieved by experimenting with video and application sharing when trying to complete mathematical tasks. This indicates that bandwidth and communication modality has an impact on feelings of Social Presence. Shih and Swan [2005] have presented work indicating that the tone of communication affects feelings of Social Presence, again indicating that it is not just a property of the communication medium. Hauber et al. [2005] found that face to face communication was associated with higher levels of Social Presence than 3D video conferencing which was ranked higher than 2D video conferencing.

Connell et al. [2001] have demonstrated that when analysing telephone, face-to-face and Instant Messaging conversations for levels of Social Presence, the telephone was reported as generating greater feelings of Social Presence than the other media. This occurred in both laboratory and field-study settings. This is a result which is impossible to explain if Social Presence is a mere quality of the communication medium; you would expect face-to-face to be highest. Connell argues that Social Presence must be formed to a level that is sufficient to complete the relevant task, suggesting that the task, the relationship of participants and the medium are all involved in the level of Social Presence felt, "people choose particular media to perform particular types of tasks, and that the medium chosen influences interpersonal interactions" [Connell et al., 2001].

Huijnen et al. [2004] demonstrated that Social Presence is increased by the use of peripheral video. The work is particular interesting as it investigates background communication, where the primary goal is watching TV and the communication acts as a secondary task. The experiment looked at groups watching a football match together on the TV, with remote partners being represented by sketchy video, full video or not at all. The participants were friends, not lovers, but this does not weaken the conclusions which are drawn. The study uses the IPO-SPQ measure of SP which we have chosen not to use but is well regarded as a measure of Social Presence (see Chapter 3).

de Greef and IJsselsteijn [2000b] have presented work which indicates that the use of video, above and beyond a photo sharing application, increased feelings of Social Presence. Nguyen and Canny [2009] have presented similar work, indicating that the framing of a video has an impact upon people's feelings of empathy.

Kang et al. [2008] and Kang [2006] demonstrated that there was no difference between unmodified video and modified video feeds in terms of Social Presence when talking on a mocked-up smartphone. In comparison, avatars were rated lower than both types of video. This work supports our argument that although communication media have an impact, it is not the only factor in determining feelings of SP. However, the work is limited in that the participants did not know one another before the experiment and the task was determining whether their experimental partner would be suitable to share an apartment with. Although a realistic situation, going beyond considerations of information exchange, the lack of a prior relationship between participants will clearly affect their experiences of Social Presence, casting doubt on it's applicability to our interests.

Nowak and Biocca [2003] found that within a virtual environment, people reported higher Social Presence from a less anthropomorphised avatar than a highly anthropomorphised avatar or the absence of an avatar at all. Their reasoning for this result was that the more realistic avatar set expectations higher than the medium could deliver, creating lower feelings of SP. Although of interest, again demonstrating that the way the medium is used has an impact on SP, there are a number of flaws in the work. The measure of Social Presence, although nominally based on [Short et al., 1976], changes the nature of the measure such that participants are not rating how close they feel to a pair of semantically-opposed words (e.g. cold/warm) but are answering questions such as "To what extent did your partner seem 'real'?", responding between 'very real' and 'not real at all'. Such changes may be justifiable but the paper does not discuss why the questions have been changed, nor what the evidence is regarding using this new set of questions. As such, there is no evidence to suggest that the measure is either valid or reliable. Beyond that, the task participants completed was extremely artificial. Structured into turn-taking, participants merely introduced themselves and explained their skills at finding information online. There is no sense that this task relates well to actual use of the virtual environment, weakening the impact of the study.

Lee and Nass [2003] found that Social Presence is enhanced when the synthesised voice tone of an audio clip on a book-buying website matches a participant's personality traits. Introverts reported higher SP from hearing an introverted voice and extroverts reported higher SP from extroverted voices. However, the study is somewhat weak with regards to it's 'measure' of Social Presence, using four free text questions the authors constructed themselves. As we go on to discuss in Chapter 3, measuring SP is not easily accomplished. Although there do exist a number of standardised measures, many of which could be understood in terms of feelings of Closeness associated with single acts of communication, but Lee and Nass do not use any of these accepted measures of SP within this study. As such, we must be somewhat wary of the results they report. We go on to discuss measures of Social Presence and Closeness more comprehensively in Chapter 3.

The lightweight sharing of photos has been shown to foster a sense of Social Presence [Counts and Fellheimer, 2004]. Although the definition and measurement of SP is somewhat loose, Counts and Fellheimer have demonstrated that only a small amount of information is needed to increase feelings of connectedness. This is of relevance as it again demonstrates how the generation of SP is not simply a matter of aggregate cues, as Media Richness theory might predict.

What these studies show is that the design and use of communication media, alongside other factors, can impact feelings of Social Presence. We need to make clear that none of these

studies discuss *why* the technology has an impact on feelings of Social Presence. It is this information which is needed to create communication technologies which best support social presence. We will return to this issue at the end of this Section. We should also note that we have identified that many of these studies suffer form methodological weaknesses with regards to the measurement of SP. This is an issue which we discuss in depth in Chapter 3.

There has been a move towards investigating Social Presence using highly novel and tangible interfaces. One of the reasons for this is that "touch remains a relatively unexplored yet emotionally vital aspect of much intimate communication" [Howard et al., 2006, p. 910]. Those tasks in which interpersonal relationships are important are sensitive to medium. There is a cultural understanding that for some situations – such as telling a close friend that you can not attend their wedding or extending a marriage proposal – some communication media, such as face-to-face, would be better than others, such as a SMS. As such it is important to investigate a variety of media for communication with regards to interpersonal relationships and Social Presence. It also suggests that different task types will elicit different experiences. This has an impact upon studying the concept. If performing experiments then the specific task involved needs to be carefully selected. Alternatively, if field testing it is likely that over the cause of daily life that some tasks will occur which carry significance with regards to the relationship in question.

There is a minimal amount of work which considers how experiences of Social Presence impacts people's relationships. Shih and Swan [2005] have investigated Social Presence and its effect within distributed learning systems. They found evidence of a strong correlation between student's perceptions of Social Presence and their satisfaction with instructors. The perception of Social Presence had a direct influence upon the perception of the relationship between the participants in a mediated conversation. This is significant as this project seeks to reinforce relationships; Social Presence is a means by which to achieve this.

Markopoulos et al. [2003] have successfully demonstrated that Social Presence can be used as a means of improving people's communication practices. Their study looked at the social visits which occur between the elderly and their grandchildren before developing a communication technology intended to help replicate these visits. Social Presence was taken as a design goal for the design of the technology. Assessed through diaries and interviews, the authors argue that using SP as a design goal resulted in a technology which did not mimic physical presence but offered an alternative. The technology was found to support a sense of 'being together' which we argue indicates that the system affects broader relational change though supporting the relationship beyond specific acts of communication. The exact findings of the study are not directly relevant to this thesis given the substantial differences between grandparental relationships and LDDRs. Although limited in that the study did not attempt to directly measure feelings of Social Presence or any broader relational concept, the study is significant because it demonstrates that Social Presence can be thought of as the underlying concept for affecting relational change. That is what this thesis aims to do.

We have noted that no studies of Social Presence has systematically analysed the impact relationship type and relationship distance on feelings of SP, nor have they analysed a large number of communication technologies to determine which design facets assist in creating a sense of presence. Kim et al. [2007] did analyse communication use within Korea and determined that mobile phones tended to be used to support strong social ties whereas text-based media were used within weak-tie relationships. Face to Face was used across all relationship types. We

should however note that this refers only to using the medium rather than feelings of Social Presence. There has been little consideration of how SP relates to other concepts although Huijnen et al. [2004] proposed that SP should be placed in the context of other concepts (in this case Group Attraction) to better understand when SP is desirable. These are important questions as they determine (1) whether Social Presence is a concept worth analysing within LDDRs and (2) which properties of communication technologies are associated with high levels of Social Presence. After setting out the methodological position of this thesis, we discuss our investigation of these issues in Chapter 4.

We should note that Social Presence is not the only theoretical construct to underpin and motivate the work in this thesis. In the next two sections we shall discuss closeness and emotions, clarifying the phenomena, explaining their relevance to interpersonal relationships, how the phenomena relate to Social Presence and finally how they are used within this thesis.

2.5 Closeness

Before moving on to discuss the broad methodological position of this thesis, we will explore the concept of Closeness. It has previously been noted that to best utilise our understanding of Social Presence, we need to understand it's connection to other relational concepts. If Social Presence affects no change beyond the act of communication it is associated with, it is hard to argue that it is worth supporting. However, if Social Presence can be associated with some longer-term relational concept then the design of communication technologies can have a much greater impact. Closeness has been proposed as such a concept. This association is investigated in Chapter 4. In order to assess whether such an association is likely, we first need to briefly consider the literature regarding feelings of Closeness.

It has been reported that one of people's biggest source of happiness is their close relationships [Kubacka et al., 2011]. 'Close' has been used in two different ways, "as a relationship *type* (e.g., dating, marriage) and as a relationship *quality*" [Ben-Ari and Lavee, 2007]. Based on detailed interviews, Closeness has conceptualised by three major distinctions: "a relatively stable relationship *trait* versus a fluctuating situational *state*; emotional versus physical closeness; and the constructed meanings of closeness versus its expressions" [Ben-Ari and Lavee, 2007, p. 627]. The first two distinctions are fairly clear; we need to further elaborate the third distinction. The constructed meanings of closeness refers to what the psychological meaning of closeness is to an individual, how it makes people feel. The expression of closeness refers to the physical manifestation of that feeling, the ways in which people express how close they feel to another individual. It is important to note that two of these distinctions involve some form of physical contact, both emotional versus physical and meaning versus expression.

Closeness, like presence, has a familiar informal meaning. It has also been the subject of extensive research in social psychology and so can be considered in a more technical sense and in a manner that is quite distinct from the Social Presence construct. It has been defined as a multidimensional construct consisting of frequency of contact, diversity of contact and the strength of contact. Closeness is also defined in terms of interdependence [Adams et al., 2001, Berscheid et al., 1989a, Kelley et al., 1983] and self-disclosure [Aron et al., 1992, Golish, 2000, Sedikides et al., 1999, Agnew et al., 2004]. An exact definition of Closeness is of less interest than three key elements that underpin the different conceptualisations of Closeness.

The first is that Closeness can be considered in terms of it being both a relationship type and a relationship quality. The second is that communication acts are acknowledged to influence feelings of Closeness [Altman and Taylor, 1973]. Finally, Closeness is a longer-term relational concept than Social Presence: "social bonds do not grow and then stabilize forever. Some reach plateaus and the grow further; others become undesirable and either break-up or revert to an earlier level of intimacy of exchange" [Altman and Taylor, 1973, p. 4].

Golish [2000] reported 170 turning points in parent-child relationships, where a turning point is an activity or moment in time where the relationship changes in some way. Both 'Physical Distance' (including moving further away) and 'Activities Together' (including spending more time together) were identified as specific turning points where feelings of Closeness changed. Although based on parent-child relationships, it is conceivable that similar turning points exist in dating relationships. In short, all friends, at some point, started off as being strangers; unfortunately, some will also finish up that way.

Measurements of Closeness have been demonstrated to be predictive of the break-up of romantic couples [Berscheid et al., 1989a]. People who report their relationship to be high in Closeness report more satisfaction than those in low Closeness relationships [Aron et al., 1992] and Close relationships are also more stable and less likely to terminate than less close relationships [Berscheid et al., 1989b]. This research highlights how significant Closeness as a concept is.

The variety of concepts relating to the term 'closeness' could be an artefact of the fact that different people understand closeness in different ways [Parks and Floyd, 1996]. Furthermore, distinguishing between closeness and intimacy is not straightforward. Parks and Floyd [1996] undertook a self-report survey with 270 college students who were asked "what does being 'close' in this friendship mean to you?' and 'In what ways, if any, does closeness differ in your same- and opposite-sex (platonic) friendships?" alongside "whether they would use the term 'intimate' to describe their target friendships" [Parks and Floyd, 1996, p. 91]. They report three different relationships between closeness and intimacy; around half of their participants appeared to view them as equivalent, a quarter reporting that intimacy implied either a romantic/sexual component and the remaining quarter arguing that intimacy implied a more intense close relationship. Intimacy is generally thought of in terms of deep relationships even if not described in such terms (e.g. [Mackey et al., 2000, Argyle and Dean, 1965]) while others have investigated the common themes which exist across multiple definitions (e.g. [Moss and Schwebel, 1993]). In reviewing definitions of intimacy, Kjeldskov et al. [2004] identifies several consistent themes. Of interest is the fact that both Physical Intimacy (i.e. touch) and Presence (both tele- and social-) are identified as common to definitions of intimacy.

To summarise, "Communication skills should contribute significantly to how well relationship functions are fulfilled and how much happiness people derive from relationships" [Burleson et al., 2000, p. 248]. Communication is key to how close individuals feel towards one another. We explore whether there is a link between Social Presence and the longer-term feeling of Closeness in Chapter 4 after discussing the methodological position of this thesis.

In terms of the relationship between Social Presence and Closeness, in Chapter 4 we hypothesise that within a given relationship communicative acts with high levels of SP increase feelings of Closeness and acts with low levels of SP decrease feelings of Closeness. This corresponds with the concept of Closeness as a relational quality where Closeness is in some way a longer-term feeling of the same phenomenon as SP. We go on to describe this phenomenon as 'emotional connectedness'.

We also recognise that SP and Closeness can be linked through the concept of Closeness as a relationship type. We would expect that relationships which can be characterised as being 'close' would be predisposed towards stronger feelings of Social Presence due to the pre-existing emotional bond between the interlocutors. For example, we would expect a dating relationship to be predisposed to have higher levels of Social Presence than a friendship.

Finally we need to consider how the concept of Closeness is used throughout the rest of this thesis. Broadly speaking, it is mainly used to assess whether the devices we design provide a level of relational support over a longer time scale than Social Presence. It is also used within Chapter 4 to investigate whether there is, as we have hypothesised, a direct connection between feelings of Closeness and feelings of Social Presence.

2.6 Emotions

In terms of defining what an emotion is, there are broadly two distinct groups. Spinozists construe emotion as an intentional attitude whilst Humeans take it to be a non-intentional state, a feeling [Zemach, 2001]. We do not take a position on this debate, nor are we particularly interested in the division between the cognitive or phenomenological approaches to emotion. For the purposes of this thesis we will use the model definition that Kleinginna and Kleinginna [1981] provide:

> "emotion is a complex set of interactions among subjective and objective factors, mediated by neural/hormonal systems, which can (a) give rise to affective experiences such as feelings of arousal, pleasure/displeasure; (b) generate cognitive processes such as emotionally relevant perceptual effects, appraisals, labelling processes; (c) activate widespread physiological adjustments to the arousing conditions; and (d) lend to behaviour that is often, but not always, expressive, goal-directed, and adaptive"

Phenomenological constructs concerning emotion have a well-established structure based on the temporal period over which they operate and the presence or absence of relevant objects. **Emotions** are object-directed, short-term and involve a relationship with a particular object. Emotions are often described in terms of valence (i.e. positive or negative) and intensity (i.e. strength of feeling). **Moods** are not directed at objects and tend to be more general. Moods are more enduring than emotions though the concepts are related; a person's mood biases the emotions they experience and a person's emotions contribute to the mood they are in. There is a further distinction with the long-term concept of **sentiment** towards an object which is based on expectations from accumulated direct experiences, generalization or social learning [Frijda, 1994].

Emotions are of interest to us with regards to their function within close personal relationships. Emotions are considered to be extremely important in maintaining interpersonal relationships (e.g., [Buck, 1984], [Izard, 1991]). Emotions and their many manifestations are profoundly relational, they occur in significant part to coordinate social interactions within relationships [Tiedens and Leach, 2004]. Some have argued that "feelings may be more central than behaviour is to what most people mean by relationship" [Planalp, 2003, p. 98].

Emotions expressed by individuals shape the content and direction of relationships. For example, the occurrence of brief emotions such as contempt or amusement reveals a great deal about the likelihood that a couple will stay together or dissolve [Gottman and Levenson, 2000].

Having established the essential role emotions play within interpersonal relationships, it is now necessary to consider the relationship between Social Presence and emotions. A naive assessment would simply be that communication acts containing positive emotions will engender higher levels of SP than acts of communication containing negative emotions. This speaks to a particular weakness in how we understand SP in that there is no distinction between valence and intensity. Let us take as an example a couple having an intense argument over the telephone. They may have a strong sense of presence to one another but the emotional context is a negative one.

However, Social Presence has been conceptualised as being a uni-dimensional concept. In terms of this thesis we thus accept the naive assessment that high SP is linked to positive emotions and low SP to negative emotions. In part this is due to the findings in other studies of relationships where "it seems that unhappy couples will endorse almost any negative item, and happy couples will endorse almost any positive item about their marriage" [Gottman and Levenson, 1986, p. 32]. As such, throughout the rest of this thesis we will treat any indication of a positive emotional experience as evidence that our devices are helping to support the couple.

Having established what is meant by the terms 'Closeness', 'Emotions, and 'Social Presence' within this thesis, it is now necessary to consider three further sets of literature. We first consider what is meant by 'communication' and how what is known about communication in intimate relationships can assist us in designing highly Socially Present technologies. Secondly we analyse the large number of communication devices which the HCI community have developed to support social relationships. In addition to establishing that many of these devices suffer from a lack of evaluation, four design facets are identified as being common to these devices, namely personalisation, effort, sensory medium and metaphor. We note that although some devices have been developed based on strong metaphors of co-located behaviours, this is an area which is worth exploring further. Finally, we argue that the potential for mimicking aspects of co-located behaviours in LDDRs forces us to consider using touch as an interaction technique.

2.7 Communication

This thesis focusses on the design of communication technologies to support long distance dating relationships. We have already established that communication technologies are the primary means through which LDDRs are supported. There is no evidence that LDDRs use communication technologies more or use different types of technologies. Long distance couples appear to focus more upon emotional communication than their GCDR counterparts. As such, it is worth considering both what communication is and what we know about communication which might be of use when considering supporting LDDRs.

The Oxford English Dictionary defines communication as "the transmission or exchange of information, knowledge, or ideas, by means of speech, writing, mechanical or electronic media" [Oxford University Press, Accessed May 2012]. This corresponds with a simple sender/receiver model of communication such as that proposed by Shannon and Weaver [1963]. The model

consists of five elements, namely an information source, which produces a message, a transmitter, which encodes the message into signals, a channel, to which signals are adapted for transmission, a receiver, which decodes the message from the signal and finally a destination, where the message arrives.

A sixth element, noise, is any interference with the message travelling along the channel which may lead to the signal received being different from that sent. The model is illustrated by Figure 2.1.

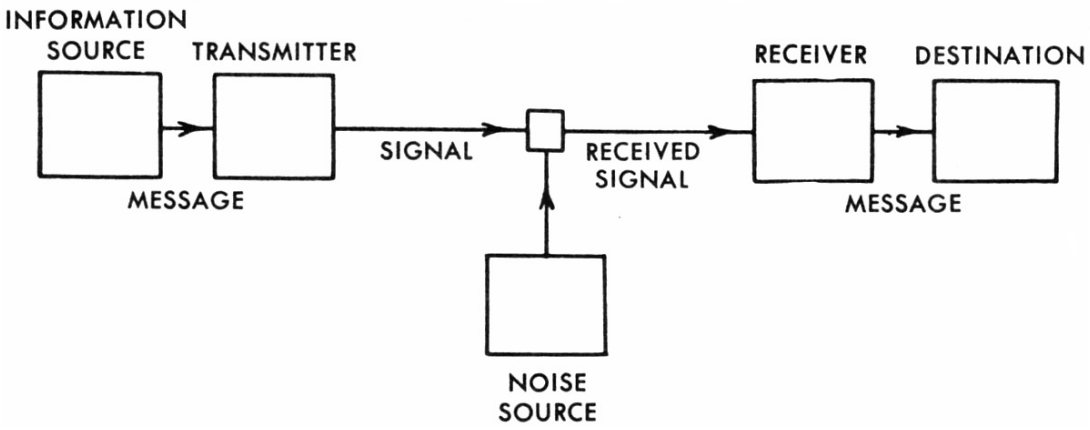

Figure 2.1: The Shannon and Weaver [1963] Model of Communication

The Shannon and Weaver model was designed for use in engineering and must be treated with caution when considering human communication. The model does not take into account that the successful reception and decoding of the message is not the same as achieving an understanding of the message. This is because it assumes routine decoding will be complete and unambiguous. Furthermore, by emphasising the properties of transmission rather than of understanding, the Shannon and Weaver model disregards the importance of nuances in the encoding and decoding of emotional exchanges, something which is key to supporting LDDRs.

The model proposed many features of communication which are now accepted but these are not the primary concerns of this thesis; we are not focussing on the development of a new communication network; our focus is on developing new devices and interactions which utilise existing network capabilities to reflect the emotional connectedness of people in LDDRs.

It is worth discussing phatic communication as it is so distinct from the use of communication as a method to exchange content. Not all communication exists in order to exchange content; phatic communication exists to establish a link between conversational partners [Hoffmann et al., 2007]. For technically-minded people, the networking command 'ping' has been used as an analogy to phatic communication [Makice, 2009]. In speech, small talk is often used as an example.

Based on a series of cultural probes, Kjeldskov et al. [2004] identify that much intimate communication is on an emotional rather than factual level, an idea which fits neatly into the phatic communication model. It is worth noting however that the argument isn't that *all* intimate communication is emotional but that it deserves perhaps more attention given our thesis aim of creating a sense of Social Presence within acts of communication.

2.7.1 Idiomatic Communication

Idiomatic communication illustrates how the meaning of a communication act can go beyond the content which is actually shared. "Idiomatic communication consists of words, phrases, and non-verbal communication, such as gestures, that have unique meaning for relational partners" [Dunleavy and Booth-Butterfield, 2009, p. 417]. Idioms are distinct from other relational terms such as 'honey' or 'sweetie' as these are not unique to a particular relationship.

We are not that interested in the means by which these idioms support relationships (see [Bell et al., 1987]), just in the fact that they do. Idioms are highly prevalent; some studies have suggested that no intimate relationships have zero personal idioms (e.g. [Hopper et al., 1981]).

Similarly to much of the work on LDDRs (see Section 2.3), considerations of idiomatic communication are predominately survey based. After surveying 275 college students in romantic relationships, Dunleavy and Booth-Butterfield [2009] found that people in relationships which are beginning use more idioms than people in relationships which are ending. More importantly, relational partners who were more satisfied with their relationship used a larger number of idioms than partners who were dissatisfied. Surveying 154 couples, Bruess and Pearson [1993] found that satisfied couples reported more use of idioms than non-satisfied couples.

Idiomatic communication creates a sense of 'we-ness', of exclusivity, thus reinforcing the relational bond between the couple. Idioms communicate intimacy by virtue of their very existence as they "are a jointly constructed lexicon that partners devise for concepts that are important to them" [Burleson et al., 2000, p.254]. As such, we might expect that the use of idioms within any act of communication might increase the sense of Social Presence. This sense of 'we-ness' also bears a resemblance to the Inclusion of Other in the Self (IOS) measure of Closeness discussed in Chapter 4. The IoS scale considers Closeness in terms of how much the couple considers themselves to be part of the couple as distinct from being a pair of individuals. Idioms could thus be construed in terms of being an element of Closeness.

As we will go on to see in Section 2.8, many note-sharing systems have found that participants use personal idioms in the notes that they share. This demonstrates that technologies to support LDDRs can be designed which utilise a couple's pre-existing idioms or encourage the creation of new ones.

2.7.2 Message Formulation

The form in which a message is externalised in has an impact on what the message can be. This is partially due to the form that the message must take, for example "by itself, a photograph cannot deal with the unseen, the remote, the internal, the abstract" [Postman, 1985, p. 72].

Socrates argued that concepts such as Justice cannot exist without writing, as only when the term is externalised into writing is it fixed, free from context. Plato went on to recognise that the advent of writing meant that all general terms could be pondered [Abram, 1997, p. 111]. There is a difference in what different presentational forms can represent and also the skills needed to interpret them – "pictures need to be recognized, words need to be understood" [Postman, 1985, p. 72].

How these forms are transmitted makes no difference as to the messages which can be constructed using that presentational form. Whether a photo is sent by snail-mail or over email,

a piece of writing sent by email or through morse code, the message remains the same.

In terms of design, what this highlights is that it is necessary to consider the type of content we want to be exchanged when selecting the form the communication messages will take.

2.7.3 Gift Giving

Communication can be characterised as a process of gift-giving [Mauss, 1954]. "In intimate relationships the significant other is often reminded that 'they are indeed significant'. People remind each other through gestures actions and gifts" [Kjeldskov et al., 2004, p. 103]. Common examples of gifts which convey intimacy include flowers, rings, secret notes and love letters though more traditional forms of communication have been thought of as gifts. The exchange of SMS messages has been characterised as a process of gift exchange amongst teenagers [Taylor and Harper, 2002, 2003].

"It is commonplace for artefacts and objects of various kinds to be exchanged as symbols of affection. Love letters, jewellery, flowers, chocolates and other missives of various kinds are often used as tokens of affection and commitment within intimate relationships" [Gibbs et al., 2005, p. 2]. Gift giving is considered an intimate act partly because it communicates the values which people assign to their significant others [Cheal, 1987, Ruth et al., 1999, Cheal, 1986].

Characterising communication as a process of gift-exchange is of interest as it highlights the importance of reciprocity in the process of communication. Especially within asynchronous communication technologies, receiving a message creates an obligation to reply. It therefore becomes necessary to consider whether the design of any communication technology contains elements of reciprocity or not. Gift-giving also creates a unique shared experience which could result in increasing the shared memory of the couple, enforcing a sense of 'we-ness'.

2.7.4 Non-verbal Communication

We should note that not all communication is verbal. Koerner and Fitzpatrick argue that "most relational information is not exchanged at the content level of the messages, rather it is contained in the non-verbal behaviour that accompanies verbal messages that is ostensibly about something else entirely" [Koerner and Fitzpatrick, 2002, p. 35]. Body language is one commonly stated example of non-verbal communicative behaviour. The absence of body language, the refusal to shake hands for example, can constitute an extremely important social act [Argyle, 1976]. Bull [1984] has shown that even young children can discern a couple's relationship based exclusively on body language. Moods and emotions can become infused into people's gestures and manner of speech which others can recognise, interpret and understand. People do not completely change their behaviour due to the communication medium being used. In Japan, people sometimes bow at the end of a telephone conversation, and in America, they sometimes nod on the telephone [Clark, 1996]. These are clearly visual ways of communicating behaviour which are not shared between the communication partners. People seemingly struggle to separate those signals which will be communicated and those actions which they normally perform when communicating in that fashion. Given that we are interested in supporting relationships, this suggests that we should consider incorporating non-verbal expressive cues rather than relying uniquely on word-based technologies.

This leads to the long-running debate of whether face-to-face communication is superior to any other form (i.e. mediated communication). Clark [1996] agrees with the linguist Fillmore who argues that "the language of face-to-face conversation is the basic and primary use of language, all others being best described in terms of their manner of deviation from that base" [Fillmore, 1976, p. 91]. Cockburn has argued that the 'richness' of the medium is key and thus all non face-to-face communication media are limited due to an inherently restricted bandwidth leading to reduced richness [Cockburn and Jones, 1995], a similar argument to that of Daft and Lengel [1986] who proposed the Media Richness Theory. Fish et al. [1992] have argued that face-to-face communication supports relationships by the manner in which it highlights the other people in the conversation. In communication systems such as email this support is absent as all messages are transmitted to and from abstract entities, namely email addresses. It is difficult to argue with either of these points – we have evolved to communicate in a face-to-face manner and more cues are likely to be better than fewer cues.

However, as Hollan has argued, such an approach will always limit our thinking to replicating or imitating the mechanisms of one medium with another rather than using the medium in a suitable manner [Hollan and Stornetta, 1992]. For example unlike emails, face-to-face communication records no 'history'. This demonstrates that communication technologies can offer features to enhance the powerful nature of face-to-face communication. We should thus not constrain ourselves to designing technologies based purely on existing media (including face to face) but instead consider what useful aspects can be used within our designs.

Richness is not the whole story, as we discussed in Section 2.4. CMC technologies are frequently used in intimate communication. Byrne and Findlay [2004] has shown that SMS is used to initiate romantic relationships and [Grinter and Eldridge, 2001, Taylor and Harper, 2002, 2003] have all demonstrated that SMS has been used to maintain relationships and to coordinate and chat with friends. The huge popularity of online dating websites also bear this conclusion out. Kirk et al. [2010] analysed the use of video conferencing CMC technologies to support intimate communication and Dimmick et al. [2000] found that the introduction of new technology (namely email) had an impact on the technologies people used to remain in contact. Our own work in the previous Chapter highlights the wide range of technologies that people use to remain in contact with their distant partners. We now turn our attention to analysing a large number of devices from the research community, designed to support LDDRs or intimate communication more broadly, asking how is the person presented and how might their moods be reflected through the communication system?

2.8 Devices to Support Social Presence

"Technology might help bridge the physical distance between people who want to be together. Anybody who has been in a long-term relationship knows that telephones and email provide only a superficial connection with one's partner" [Gaver, 2002, p. 11]. Although telephones and emails can fulfil the need to exchange information, they were not designed to create a sense of emotional connectedness. HCI researchers have responded by designed a number of devices which have focussed on communicating in an emotional way, fostering a sense of Social Presence. Some work has been done on technologies suited to business use, using a person's presence or availability within a given location e.g. [Cheverst et al., 2007]. However relatively little has

been done at home where technologies could support emotional connectedness through sharing moods and attitudes in addition to their presence and availability. Home and work environments contain different relationships which need different kinds of support for different purposes. After describing a number of devices, we will draw out significant features and comment upon those factors that are common across the devices as design facets for Social Presence.

At this point it is necessary for us to discuss emotional connectedness. In Chapter 4 we stated that we believe that Social Presence corresponds to the level of emotional connectedness engendered in each act of communication. It is also the basis of our third research question:

> **RQ3: Do novel designs for devices based on the design facets from RQ2 engender positive feelings of emotional connectedness?**

We have not yet defined what we mean by emotional connectedness. This is because the term, unlike Social Presence and Closeness, is not a specific concept from the literature, being a descriptive term rather than an operationalised scale. Here we use emotional connectedness as a catch-all term encapsulating Social Presence, Closeness, and any qualitative data we collect associated with relationally meaningful acts. In other words, high Social Presence ratings, high ratings of Closeness, and text which refers to positive emotions or the relationship more generally can be taken as indicating a sense of strong, positive emotional connectedness. This allows us to utilise the combination of the qualitative and quantitative data collected throughout this thesis to make inferences about the emotional status of the relationship and inform our assessment of technologies used within Long Distance Dating Relationships. We do not use the term to create a new concept for use in the literature; instead we are trying to formulate a way of using both quantitative and qualitative data to inform our understanding of a relationship.

Much of the early work in social communication technologies was born out of an interest in supporting informal conversation in the workplace and assisting people complete their tasks (e.g. [Kraut et al., 1988, Fish et al., 1993, Heath and Luff, 1991, Bly et al., 1993, Dunne and Raby, 1995, Root, 1988, Fish et al., 1992]). There is a common thread which runs through this work suggesting that the communication which best helps the formation and maintenance of working relationships is low-cost, frequent, informal and on-the-fly. As all these properties are satisfied in spatially local environments, some authors have suggested that this is best; however it is the attributes of interlocutors, embedded in their behaviour, not the physicality, which are of importance. As this research is focused upon workplace environments, it is unclear as to whether the same attributes also apply to personal relationships. We must then focus upon those communication technologies specifically aimed at supporting intimate relationships.

Throughout the rest of this section we consider a range number of communication technologies, designed to support personal relationships. We attempt to derive an understanding of those design facets which have been investigated and how they may be used to support a long distance dating relationship. The remainder of this section is structured by the underlying metaphor of the device. We first discuss systems intended to share an awareness of a person's state (such as location or availability). After placing these systems beyond the scope of this thesis we discuss those systems which have utilised ambiguous signals as a means of communication, forcing participants to interpret the meaning behind a specific message. We then discuss devices which have been based on augmenting existing artefacts, such as slippers and rugs, and turning them into a communication system. We then discuss the sub-set of augmented artefact systems which

exchange minimal cues. The penultimate set of communication technologies are based on the mimicry of co-located behaviours such as hugging and holding hands. Finally we discuss note sharing systems. Although strictly speaking note sharing is a behaviour, due to the volume of systems based on exchanging notes it makes sense to discuss them independently of the other behaviour-based systems.

This structure may appear somewhat arbitrary but it is not. Firstly, the progression through these various underlying metaphors follows a rough chronology as people's interest in various approaches to design have grown or waned. Secondly, the selection of an underlying metaphor of a device has ramifications in terms of what form the device takes. This makes it a suitable mechanism by which to compare and contrast the wide variety of devices which have been designed. We should also note that the following sections only discuss a small proportion of the devices we've analysed. The full analysis can be found in Appendix A.

2.8.1 Awareness Systems

There is a distinction within connected-oriented technologies between awareness devices – those that monitor and communicate a persons state – or an explicit device whereby a person sends a one off message. "On the sender side, awareness information is either captured automatically via sensors, and continuously transmitted to the remote side, or users are required to provide manual input, whenever they want to transmit information" [Röcker and Etter, 2007, p. 286]. In the context of this thesis, we define an awareness system as one which fits the definition presented by Gellersen et al., where "context-awareness indicates the ability of a system to obtain and use information on aspects of the system environment" [Gellersen et al., 2000, p. 3].

Numerous researchers have considered sharing an awareness of location (for example, [Bales et al., 2011, Sellen et al., 2006a, Barkhuus et al., 2008]), an awareness of availability (for example [Dey and de Guzman, 2006]) and an awareness of activity (for example [Pedersen and Sokoler, 1997, McEwan and Greenberg, 2005]). Privacy is typically a major concern within awareness systems given that such systems remove control of information dissemination away from the user. "In general, the more information transmitted about one's actions, the more potential for awareness exists among those receiving the information. At the same time, however, the more information transmitted, the more potential for violation of one's privacy exists" [Hudson and Smith, 1996, p. 249]. The trade-off between privacy and awareness includes details about the type, quality and volume of information transmitted.

Within this thesis, awareness systems are beyond the scope of interest. This decision was taken for two reasons. The first is that these questions of privacy, although extremely important, are not of interest. Secondly, awareness systems lack the element of intent; the user of an awareness system has devolved control of sharing information to the awareness system. This changes the meaning behind receiving a message; an awareness message has not been intentionally sent by your partner. This additionally means that it is dubious as to whether Social Presence is a valid concept to discuss with regards to awareness systems. As such, we have decided that, despite their potential for supporting LDDRs, awareness systems are beyond the scope of this thesis.

2.8.2 Ambiguous Communication Systems

Some of the first work on communicating intimacy used ambiguity as a means of connecting people together. The value of these abstract, ambiguous technologies is that the emotional meaning of the message is derived from a shared understanding of the relationship; although this could cause frustrations and anger when messages are misunderstood, when they are interpreted correctly (typically as 'I'm thinking of you' messages), the meaning could be extremely powerful. Additionally, ambiguous communication lends itself to the development of personal idioms which could strengthen the sense of 'we-ness' experienced by the relationship.

Three systems are presented by Strong and Gaver [1996] which are some of the earliest communication devices based on the concept that companionship is considered a goal in of itself. They are further elaborated upon in [Gaver, 2002].

Feather is a system whereby a traveller carries an electronic picture frame. When handled, a small feather drifts within a clear plexiglass cone in the partner's home. *Scent* creates the smell of oil heated in a small bowl which indicates that a connection has been made. The third, *Shakers*, consists of two devices whereby moving one device causes the other to move analogously. Interestingly, all three of these devices are intended to be a one way communication system and assume that the other person is at that moment in time at a home location which is a large limitation of the devices. All three of the devices use the ambiguity of the message to increase engagement with the devices compared to awareness technologies which have often been specialised to give information for particular work activities.

Two further devices have been described by Gaver [2002] which continue to utilise ambiguity as a resource for design, namely an ear warmer which heats when a partner object is warmed and a device whereby patterns of light on a kiss communicator reflect the breath of a distant lover. Although (arguably) aesthetically pleasing, all five systems have not progressed beyond the design stage. Thus the practical concerns of constructing such devices, and evaluating their use, which are both of significance, are not, and can not, be considered. Ogawa et al. [2005] propose devices similar to Gaver in as far as they advocate "faint information such as light, wind and touch" but other than describing three such devices, the paper has no details of construction or evaluation.

Brave and Dahley [1997] used the idea of ambiguity when designing their meaning-free touch-based device. The 'inTouch' communication device is based on two sets of 'rollers'. Each roller consists of a series of movable cylinders. Moving the cylinders on a roller creates the same effect on the partner roller. In this device the issue of the level on control over a given roller has been left to the users of the system. The aim of the 'rollers' is to create a sense of intimacy which is interpreted by it's users. There is a potential problem that spinning the 'rollers' hard could indicate excitement but the other person could interpret this as anger. There is again a lack of evaluation of the inTouch rollers, meaning that few conclusions can be drawn regarding the success of the system in engendering a sense of intimacy through ambiguous touch.

Joseph Kaye has published extensively on his virtual intimate object (VIO) which takes ambiguous communication into a software-only system; [Kaye et al., 2005, Kaye, 2006, 2005a,b]. The VIO is a simple task-bar based piece of software which consists of a coloured circle. When the partnered circle is clicked on, your circle is coloured red. The colour then gradually decays over time back to blue. Five couples used the system for a week, completing a logbook consisting of open-ended questions about their use of the system. Participants used VIO extensively

and 'many' continued to use the system after the evaluation period of the system. Participants interpreted the clicks differently and developed their own concepts of meaning (for example, an early morning click signified good morning for one particular couple); each couple developed their own personal idiom around what different clicks signified.

There are two important points to take from the VIO research. The first is that a minimal amount of ambiguous communication can help create an emotional bond between participants. This is likely to be due to the level of interpretation that closely bonded couples can provide to minimal information. It is also worth noting that the communication being exchanged in this example is phatic, not explicitly symbolic. The second point to take is the level of reciprocity that is demanded from a minimal communication system. Behaviours included click wars (*"...it is a contest to keep up with each other, click for click"*) and gift giving. Participants did report that using the system was an obligation, not an optional activity and it is worth considering if this is something to be avoided. It should be noted that this appears to be an emergent behaviour, occurring dependent on how participants decided to use the system, rather than a result of the design of the system.

The evaluation carried out by Kaye is a pilot study; a limited number of participants used the system over a very short period. We must interpret the results in light of this; there is no indication whether users would still be engaged by the system after using it for a month.

inStink is a result of Kaye's interest in ambiguous communication, coupled with a novel interaction technique [Kaye, 2004, 2000]. inStink is unusual in that it uses smells as the sensory medium through which messages are sent. As it is currently configured, when a spice bottle from a given rack is removed, the scent of that spice is produced in a remote location. Despite being unevaluated, the device is interesting, not least for it's use of a novel interaction technique. More significantly, the device can harness people's memories of a shared activity (the example used is cooking together) in order to create an emotional bond between the users of the system. This is an idea we use explicitly in the construction of the hotHands and hotMitts device in Chapter 5.

Truong et al. [2004] presented an augmented gumball machine which provides candy as a prize when someone was thinking of them. "To receive the candy and to know that someone was thinking about them was a pleasant experience" [Truong et al., 2004, p. 1204]. The activation of the gumball occurred every fifth time someone visits a particular website. This counts as producing a 'thinking of you' message. This is an interesting system as it extends Kaye's idea of 1-bit communication though it produces a tangible gift for the recipient rather than an ephemeral message. The meaning of the message remains embedded within the interpretation shared by the couple. This system raises the issue of the distinction between touch and tangibility, whether physical technologies produce messages in a physical form or simply use a physical channel to communicate meaning. We will return to this distinction when discussing each of the devices we have designed in the next Chapter.

Ambiguity has also been used as a source of inspiration in a number of papers discussing design sketches based on ethnographic work. InTouch is a system consisting of "small tokens you carry or wear to keep 'in touch' with a friend or relative. If you touch your token, your friend will receive the touch through their token – it might glow, become warm or vibrate" [Hindus et al., 2001, p. 328]. Kaye and Goulding [2004] present three tangible design sketches. The first is based on augmenting an abacus and is similar to the inTouch in it's method of interaction. The

second is the 'love egg' concept which attempts to create a relationally meaningful voice-mail system; users speak into one end of the egg and when replaced into it's tray, the message is transmitted to it's partnered egg. The partnered egg rolls around it's tray until the message is listened to. Other attempts to innovate voice-mail have found that they can create an opportunity to be playful, especially when participants use the system in unanticipated ways [Lindley et al., 2009a].

The third of Kaye and Golding's concepts is based on the behaviour of hand holding. The system is non-reciprocal; one user places their hand into a handprint which causes a linked bracelet to pulse in rhythm with the first user's heartbeat. Kaye's designs are particularly interesting as they focus on exclusive relational communication and are for a specific rather than a generic couple to use. The utility of design sketches is that they allow a wide-range of design facets to be explored; however this comes at the cost of not being able to asses the devices in a meaningful manner and demonstrate the utility of said properties.

2.8.3 Augmented Artefact Communication Systems

In addition to utilising ambiguity as a means of connecting people, a lot of work has focussed upon augmenting artefacts; taking everyday objects and adding sensors and actuators in order to create communication systems.

Dodge [1997] presented a networked bed with a variety of novel outputs, including pillows which warm up when a partner pillow is hugged to simulate a person's hug. The evaluation of this goes no further than gathering a few comments from fellow researchers. Although further work was anticipated, none can be found. This lack of systematic, rigorous evaluation is a point which we will return to, again and again, throughout this section.

Goodman and Misilim [2003] take the idea of using the bed as a medium for relationship-focussed communication, given its connotations of closeness and intimacy. The difference from Dodge [1997] is the way in which the bed is supplemented – in this example, pressure pads and heating elements are used in an attempt to replicate a partner's body heat in remote beds. How effective this is we cannot know given the lack of evaluation of the device. The value however comes from the use of a real world artefact and modifying it to replicate behaviour (i.e. sharing a bed with one another).

ComSlipper, [Chen et al., 2006], uses a *personal* artefact, an object which is intimately associated with a single individual in an emotional way. In this case, the artefact is a pair of slippers which has been supplemented with technology to develop a rather delightful communication medium. Pressure points on either pair of slippers are connected with a LED and heat pad in the other pair. Various interactions (such as foot tapping) lead to different outputs. The device illustrates some important concepts. The first is the use of an existent personal artefact to create a communication system. The intention appears to aim to utilise existing feelings to increase the emotional meaning behind any message which is sent. The second is the use of minimal interactions and outputs to create a phatic link between participants. The final concept is the bi-directional nature of the device which is very different to some of the concepts discussed in this section.

There are some significant flaws with the concept as presented by the authors. The paper presents the device as being activated unconsciously from behaviour emerging from a person's

mood. We take the position that this is unlikely; that foot movements aren't necessarily reflective of emotional state. If participants are told this is the intention, and that certain emotional behaviour matches certain output, then there is a large scope for confusion and misunderstanding. An interesting debate could be had over whether "people thinking about the availability of a receiver before they send a message" [Chen et al., 2006, p. 372], is actually a problem or not. Indeed, it could be argued that the thinking of the partner increases the worth and value of subsequent messages. Again the device has not been evaluated. The only clue to why this may be the case is the fact that the slippers are currently wired, not wireless, something likely to cause major pragmatic issues on any kind of evaluation.

Tsujita et al. [2007] presented the SyncDecor project, again intended to take advantage of sharing biorhythms. SyncLamp, SyncTrash and SyncSky are all pairs of devices which reflect the input of the other as an output. SyncSky allows couples to share video images of the sky from where the other person is. SyncLamp is based on a pair of lamps; changing the brightness of a given lamp also changes the brightness of it's paired lamp. SyncTrash replicates the opening and closing of a trash bin on a paired bin. Tsujita et al. [2008] extends the SyncDecor project by undertaking a 3-month long field study. The reported study consisted of three pairs of participants who installed SyncLamp, SyncTrash, SyncAroma and SyncTV and then got participants to keep a daily journal. The paper concludes that the SyncDecor devices helped the relationships and five participants reported that their feelings for their partner had increased. However, the actual data showing this is not reported. It also seems that relying only on the daily journal and no other kind of report (interviews or phenomenological measures for example) is not the most exhaustive evaluation that could have been carried out. However, the results do indicate the participants do feel that phatic communication devices can strengthen their relationships.

Cups have also been augmented to provide an emotional link between participants. Chung et al. [2006] added sensors and displays to a pair of cups in order to provide attentive illumination, virtual kisses, connectivity and toasting. However, with no evaluation in this paper, and no follow up work to be found, it is hard to interpret the device. It is worth noting as although Lover's Cups is predominantly based on the augmentation of an artefact (i.e. cups) it acknowledges that it is the *behaviour* surrounding eating and drinking which gives the device it's emotional meaning. We expand upon this when discussing communication systems based on the mimicry of co-located behaviours in the Section after next.

2.8.4 Minimal Cue Communication Systems

In Japan family ties are very strong – however cultural changes mean that family members no longer necessarily live near one another. "For family members that live together, the familial bond may be fostered by the small acts of daily life in a shared presence. Unfortunately, such opportunities are lost by family members living apart" [Itoh et al., 2002, p.810]. Itoh has designed a device which consists of a number of fibre optics that can be rotated and lit up. As someone walks past, the optics of the partner device move in the direction of that person and light up. Importantly the generation and reception of these exchanges are intended to blend into the everyday life of a user – no explicit act is required to generate, send or receive the signal meaning that these exchanges do not interfere with anyone's primary task. Although Itoh et al. claim that the user's family relationships were somewhat enhanced and supported by using

the system, it is not clear how the system was evaluated. The users reported acceptance of the device, but this on it's own does not form a compelling evaluative procedure.

Itoh concisely states the underlying hypothesis of this work, that "people living apart can still enjoy a feeling of togetherness by exchanging subtle cue information via a network" [Itoh et al., 2002, p. 811]. This neat summation belies the complexities that are involved in doing so.

The Digital Family Portraits project was devised to support families through the provision of information. Having installed a non-invasive sensor network in an elderly parent's house, an augmented picture frame is placed into the middle-aged child's home. The frame is updated with key information that the child may want on a day-to-day basis without having to pester their parent. In this manner, the family is supported without causing an undue burden on either member of the family. The reason for doing this? Because "geographic distance between extended family members exacerbates the problem by denying the casual daily contact the naturally occurs when families are co-located" [Mynatt et al., 2001, p. 333]. The initial evaluation lacks the necessary sensing network, instead relying on phone interviews between the researcher and participants. This minimises the conclusions that can be made from the study. A follow-up paper from Rowan and Mynatt [2005] provides a substantial, single participant, long-term study of the system. There are issues with the evaluation – specifically some of the assumptions made, including the sensor network (which couldn't deal with multiple elderly people living in the same house) – but the fact that the participants continue to use the system after the end of the study is indicative of it's success. The value of this study is that it demonstrates that there is value in exchanging information between separated members of a family without having to make a conscious effort to do so.

Some devices have tried to take advantage of couples' private languages, those phrases and actions which have deeper meaning to the couple than to anyone else. The Cube, [Howard et al., 2006], does this through the use of personalisable graphical codes on a 2.5D cube (so called due to the virtual nature of the software cube). The pilot study results are not overwhelmingly positive with participants stating that managing the content creation was arduous and that usage of the dropped over the course of the study. Additionally, "participants folded the Cube into a broader array of communication options, recognizing the Cubes advantages in mediating phatic communication in positive intimate exchanges, but preferring other devices for resolving contact breakdowns, or mediating more intensively content oriented exchanges" [Howard et al., 2006, p. 911]. This is possibly due to the nature of the device – it does not form a phatic connection and yet the content it provides is not sufficient to meaningfully communicate.

ComTouch by Chang et al. [2002] is an interesting device that is intended to be used in conjunction with other communication channels, specifically voice; combining the best facets of multiple communication types. The device converts hand pressure to vibrational intensity, experienced through holding the mobile phone. Though there is a well constructed evaluation, it focusses more upon the ergonomics and ability to feel the touch rather than ComTouch's ability to support people's relationships.

2.8.5 Behaviour Based Communication Systems

Compared to the large number of devices we have already discussed, there are only a few devices which try to mimic existing *behaviour* over a distance. These are hugging, hand-holding, kissing and entering a room.

Of these, hugging has received the most attention. DiSalvo et al. [2003] and Gemperle et al. [2003] present the design of a hugging cushion, styled in the shape most suited for hugging. Although the paper makes clear that the device has an anthropomorphic form, the actual telephony aspect of the design is less clear. This is the main criticism of the proposed device – visionary design is good, even essential. However without construction and evaluation design it is almost worthless – we are not concerned with art forms but communication systems intended for use. Without evaluation, how do you know the design has achieved it's objective?

Mueller et al. [2005] on the other hand have presented an air-inflatable vest, designed to mimic a hug. The vest was inspired from cultural probes investigating what people would like as a communication device to support their intimate relationships [Vetere et al., 2005]. The vest is activated by a partner rubbing a koala soft toy, an interesting and novel way to activate the device, intended to make the activation a playful mimic of hugging. The device also sends an acknowledgement back to the koala, creating a kissing sound. This actively involves and thanks the partner, creating a two-way link between the users, even if the links are not of the same kind.

The authors explicitly state that their "intention is not to recreate accurately the physical and emotional experience of a real hug" [Mueller et al., 2005, p. 1674]. Rather it is the user's interpretation of the phatic signal which leads to the association of emotion with the message.

When presented with the device, participants liked the idea but were concerned about many of the practicalities of using the device. It was bulky, loud, could not be reciprocated (i.e. only one vest) and 'weird'. The participants also said they would not want one. However they could not experience its use in the 'real-world' and it is likely that they could not separate their concerns over the pragmatics with the conceptual nature of the device. Participants also noted that with current 'real' hugs, people can reject them. This is interesting and not something which is generally considered – however users could decide to turn the device off or refuse to wear the vest.

There has been some minimal work undertaken on hand holding. O'Brien and Mueller [2006] consider it an important act but their prototype was rather unusual. Instead of trying to mimic hand holding, they initiated a probe to investigate whether participants wanted to hold hands when their partner was absent. They designed a yellow ball containing an embedded microchip. When participants gripped the ball the microchip logged the time and incremented a counter. There are three main things to take from this probe. The first is that participants did indeed wish to hold hands with their partners when not co-located. The second is that participants did not like to carry the device around with them. This suggests that any hand holding device should not necessarily be mobile. The third is that participants wanted a device which was more personal. How this could be achieved with a hand holding device is not clear and the paper does not expand upon the comment.

The Kissenger device is the only attempt we have seen which attempts to create a communication system based on kissing [Samani et al., 2012]. The system consists of two miniature heads which have moveable lips. When manipulating one set of lips (presumably using your own lips), the paired head replicates these manipulations. The device was evaluated through an experiment involving seven couples, some of whom were friends. Although it is good that the device has been evaluated, the evaluation process is extremely weak. Participants had to simulate an 'intimate conversation' and were forced to use 'kisses' within the conversation. This is

hardly a natural situation, invalidating the contextual validity of the evaluation. Additionally, the device was compared against video-chat kisses rather than other forms of intimate communication which could be used to replace the absence of kisses. This poorly conceived evaluation gives us little confidence in the design of the device or that kissing is a suitable behaviour to try and mimic.

The Gustbowl was not concerned with behaviour so much as ritual. Concerned with parent/teen communication after the teen has left home, van der Hoog et al. found that "what the parents miss is not regular conversations, but the moment of coming home" [van der Hoog et al., 2004, p. 775]. The solution was to place a pair of gustbowls in each home. When the teen came home and threw their keys into the bowl, sensors in the bowl detected the keys and took a photo. The image is transmitted to the parent's bowl accompanied by a shake. What is less clear is whether teens were noticing if their parent threw keys into their bowl. A short-term study was undertaken although no results were presented which could indicate an unreported negative result. The design however does demonstrate that devices can be constructed which take advantage of, rather than attempting to change, people's existing rituals and behaviour.

2.8.6 Note Sharing Communication Systems

The concept of note-sharing systems builds upon work in HCI which focussed on developing novel message exchange systems in the workplace (e.g. babble [Bradner et al., 1998, 1999] and HERMES [Cheverst et al., 2003]).

The 'Magic Box' was a project which investigated intergenerational communication between grandparents and grandchildren [Vetere et al., 2006, 2009, Davis et al., 2008, Feltham et al., 2007]. Having identified that mainstream communication technologies do not encourage playfulness, particularly within this specific user group, the research team developed the idea of the 'Magic Box'. Using a cultural probe to better understand what ideal communication would look like, both households were given a box. Any item could be placed within the box. Overnight, the 'Magic Box Fairy' swapped these boxes between the households. The Magic Box was extended into the virtual world through instigating a game of virtual hide and seek, using digital content as the contents of virtual 'boxes' which could be 'hidden' for a child to find [Davis et al., 2007]. Although the project is a glorified postal service, the research project highlights the significance of playfulness in communication, something which current communication technologies do not necessarily support. Furthermore, much of the content which was exchanged was highly personal, in contrast to many of the devices we have discussed thus far.

Thieme et al. [2011] augmented the interior of a lockable antique box with messaging technologies. Their insight was to create the 'Lover's Box' as a treasured private space, framing messages as intimate to the people who exchange them. In this way, they generated rich emotional experiences by fostering individual reflection on the content of personal messages. We agree with the authors that it is inherently hard for designers to direct interaction design for couples because it depends on elements of users personal history. That said, the evaluation of their novel, insightful system is limited. User's had to visit the research lab in order to record their message. Not only does this limit user's ability to use the device as they would within their own routine, it could affect the content of the messages. That apart, the design of the 'Lover's box', alongside it's limited evaluation, highlights the importance of communication technologies used *exclusively* for intimate communication.

The peek-a-drawer system is a note sharing system with a twist; instead of writing notes, physical objects are converted into digital messages [Siio et al., 2002]. The communication system consists of two bedside cabinets. Placing an object into one of the drawers causes a photo to be taken of it. This image is subsequently displayed on a LCD screen in the other drawer in the other cabinet.

These three systems (The Magic Box, the Lover's Box and the peek-a-drawer) all involve some element of opening a physical space, of revealing a hidden space. This suggests that the designers wanted to introduce an element of being pleasantly surprised when finding a new message and wanting this process of discovery to occur serendipitously whenever the owner thinks about opening their box.

Microsoft Research have published two emotion-based note sharing systems. The HomeNote system was an early note-sharing system intended to bind families together [Sellen et al., 2006b]. Displaying text messages, the HomeNote display allowed free-text notes to be added to particular messages. Based on five one-month case studies, social touch messages were identified as being particularly emotionally significant. This type of note-sharing system was extended in the Wayve prototype which built upon HomeNote by providing the functionality to share free-drawn pictures and annotated photographs between Wayves [Lindley et al., 2010, Lindley, 2012]. Playfulness and fun were again identified as being significant components of the value of the note-sharing systems. This expressiveness of the system, particularly in terms of emotion, has also been noted in other note-sharing systems such as the Hermes@Home project [Saslis-Lagoudakis et al., 2006]. The ASTRA project facilitated the creation of notes on mobile phones (including photos and hand-written text and pictures) which were then shared on a fixed household display [Markopoulos et al., 2004, Romero et al., 2007]. This system is worth noting as it demonstrated that it helped to 'connect' participants to one another, recorded in both the ABC questionnaire and in free-text interview and diary responses. The ASTRA system also illustrated how important effort is within relational communication; "we found that the effort invested by the sender of a message is valued by the receiver, but only when it is *meaningful* with respect to the communication message" [Romero et al., 2007]. We should note that all of these systems are based on connecting families rather than lovers so there is no evidence of their utility within the context of LDDRs.

Many other devices exist – for example Counts and Fellheimer [2004] present lightweight sharing of photos to foster feelings of social presence amongst a group of people, Metcalf et al. [2008] present a social TV experience, Gibbs et al. [2005] present a hand-shaped screen which creates a phatic connection, Chang et al. [2001] created a pair of picture frames, each lights up when the other is touched. The United-Pulse augments a ring such that it shares an individual's heartbeat with their partner [Werner et al., 2008]. Experimental evaluation appears to indicate that the concept is a pleasant one but with no working prototype, a field study demonstrating this could not be run. The peek-a-boo surrogates are miniature figurines which face the wall when an individual is not available to talk; the figure rotates to face the local person when the remote person is available to talk [Kuzuoka and Greenberg, 1999]. A system focussed on positive messaging, Posipost, was found to increase feelings of social connectivity [Kanis et al., 2008]. However these examples, when analysed, add nothing to the systems we have already discussed.

2.9 Discussion

The aim of analysing the devices we've discussed was to establish any commonalities and differences across the various devices we have presented. In addition to identifying design facets which were common across the devices, which we shall discuss in the next section, we found two broader issues with relevance to this thesis.

Designing for the home, the place where personal communication systems exist, is recognised as being difficult. As we all live in homes, we have a loaded understanding of what goes on in homes and thus what our designs should take into account. Thus it has been argued that "because the home is so familiar, it is necessary to make it strange, or defamiliarize it, in order to open its design space... [as] home appliances are loaded with cultural associations such as the gendered division of domestic labour that are easy to overlook" [Bell et al., 2005, p. 149]. There are practical concerns which are associated with research within the home; they "do not easily accommodate the numerous pieces of equipment, cables, phone jacks and electrical outlets required" [Hindus, 1999, p. 202]. Additionally, homes have particular meanings within particular locations [Grivas, 2006, Monk et al., 2010] and can be associated with particular rituals [Tollmar et al., 2000, Tollmar and Persson, 2002]. Some of the work we've already analysed, such as the SyncDecor Project [Tsujita et al., 2008], inStink [Kaye, 2000] and Gustbowl [van der Hoog et al., 2004], have already used ritual as a starting point of design. Similarly, researchers have investigated when communication could occur [Lottridge et al., 2009].

A major issue with the devices, prevalent throughout the community, is evaluating them. There are some rare exceptions (specifically [Tsujita et al., 2008, Kaye et al., 2005, Kaye, 2005a]) but the majority of devices are not evaluated. Fascinating and intriguing devices are thought of, based on a sound theoretical foundation, and then nothing happens with them. Some of the design work explores issues no one has considered before. However, many of the devices presented have not even been taken beyond the design stage. This tendency may be due to the difficulties involved in constructing or evaluating such devices. The lack of construction of some devices means that certain practical concerns around the device concepts are not discovered. Likewise, the lack of any form of evaluation is a serious weakness; not only does it mean that we can make no claims about a device's ability to support people's relationships (as it was designed to do), it also limits the designer's ability to reflect on their device and design decisions, especially given the reaction of potential users. Interestingly, in their review of touch, which we discuss in the following section, Gallace and Spence also note the lack of empirical evaluation in prototype communication devices based on haptic interaction [Gallace and Spence, 2010]. Throughout this thesis, we will improve upon this methodological shortcoming by ensuring that *all* of the devices we produce are involved in some level of systematic and rigorous evaluation. We have previously discussed in Chapter 3 the techniques we will use to both gather and analyse data about any devices we develop and the impact they have on LDDRs.

2.10 Design Facets for Social Presence

As we've previously stated, the aim of analysing the devices we've discussed was to establish any commonalities and differences across the various devices we have presented. Four distinct design facets were identified as being common across the various devices, namely Personalisation, Effort, Sensory Medium and Metaphor. A full description of how each of these design

decision is realised in each of the devices we've discussed can be seen in Table A.1 in Appendix A. Additionally there are a number of themes revealed within this Chapter which were not identified at this stage as being relationally meaningful but after further studies were recognised as being relevant. These themes are linked back to this analysis in-line with the results of the further studies.

2.10.1 Personalisation

Personalisation does not refer to the ability to changing fonts or text sizes. We would argue that it describes communication which bears the unique stamp of the other person; an element of the communication is inherently linked with the other person. For example, voices tend to recognisably identify particular people known to us. Posture and walking gait similarly vary between people and can help us to identify particular individuals. We have previously discussed how forming a personal connection was important in people's existing communication routines in Chapter 4.

Although most systems now use standardised presentation (e.g. typed) there is no fundamental reason why this should be the case. While there is a case for it in terms of clarity and understandability, in terms of intimacy, abstracting out all personalised features is likely to be a mistake. Both email and IM are fairly standardised; that is they have few personalisation features. There is however no link between being digital and a lack of personalisation features of the nature we are discussing – in particular, those devices which used voice (such as the Love Eggs [Kaye and Goulding, 2004]) and the note sharing systems (such as the Lover's Box [Thieme et al., 2011] or HomeNote [Sellen et al., 2006b]) both exhibit elements of personalisation.

2.10.2 Effort

Recent findings have indicated that the effort invested in creating a message is appreciated by the recipient of that message. Riche et al. [2010] found that elderly people in particular found that new communication media (such as email) devalued the act of communicating as the media were too easy to use. In comparison, sending a letter was perceived as harder to do and was appreciated more. Our analysis highlights that, apart from the note-sharing systems, all of the devices we've discussed have focussed on being effortless to use. This suggests that the there could be an opportunity within this thesis to explore what an effortful communication technology for LDDRs might be like. Additionally, we have previously discussed how managing time and effort was important in people's existing communication routines in Chapter 4.

2.10.3 Metaphor

Metaphor refers to the underlying nature of the device or the message being sent through the communication system. Although the desktop metaphor is the most famous example, metaphor is a concept which is well used within HCI [Gillan and Bias, 1994, Erickson, 1993, Prior et al., 2008, Frøkjær and Hornbæk, 2008]. A number of metaphors can be used to describe the various types of communication devices which we've seen, each varying in terms of the strength of the relationship to a familiar part of a person's unmediated experience.

The first is to have a completely abstract communication system where the the recipient has to interpret the meaning of any message passed through the system. This type of system could be considered to have no underlying metaphor. This is not the same as the message having no underlying metaphor; it simply means that the interpretation of these messages is down to the individual rather than the system as a whole having a base metaphor. These types of systems play off a sense of ambiguity in order to allow interlocutors to construct their own sense of meaning. These systems can use all types of sensory modality – Kaye's one-bit colour changing circle uses sight, Gaver's Scent system uses smell, Brave's touch rollers use haptics ([Kaye et al., 2005], [Gaver, 2002] and [Brave and Dahley, 1997] respectively). Ambiguous systems tend to be low effort and have little or no personalisation. Using ambiguity as a resource for design has a growing following (e.g. [Boehner and Hancock, 2006, Aoki and Woodruff, 2005, Gaver et al., 2003, Sengers and Gaver, 2006]).

The second approach is to augment an existing artefact. This is the most common metaphor behind the devices that our analysis considers. This type of system takes an existent artefact, such as a bed or a cup or a table, and supplement it with technology such that it can be used as a communication device. A good example of this is from Goodman and Misilim [2003], who present an augmented bed, fitted out with features to communicate with a partnered bed.

A third approach is to attempt to replicate a co-located behaviour over a distance. This concept takes a co-located behaviour such as hugging, kissing or holding hands and tries to replicate it over a distance. A good example of this is the hugging device proposed by Mueller et al. [2005]. People undertake these behaviours when they are together for a reason; they are also activities that they cannot typically undertake whilst living at a distance. In Section 2.5 we noted that many conceptualisations of Closeness involved some element of touch. Given the dearth of devices based on this metaphor, and our focus on supporting long distance couples, we have decided to focus on the development of devices based on mimicking co-located behaviours.

2.10.4 Sensory Medium

One of the things that is often overlooked when talking about communication media is the sense that it uses to communicate through; typically sound, smell, taste, touch or sight. For example, you listen to a telephone call (the sense used is sound), you read a letter (the sense used is sight). Our analysis shows devices have been created which use all of these senses. We should also note that there is a scarcity of devices which use haptics as their primary means of communication and those devices which do are predominantly based on mimicking co-located behaviours. As such it is necessary to explore what we know about using haptic technology as a means of interaction.

2.10.5 Complementarity

We have presented our design themes of personalisation, effort, metaphor and sensory medium as distinct concepts, meaning that any given device will have a position on each specific theme. It is necessary to consider how these themes contrast and combine to create devices which are relationally meaningful to LDDRs. We are not arguing that any decision on a given factor (for example personalisation) leads to an automatic position on any of the other factors (for

example metaphor). However there are some connections which are worthwhile to discuss at this juncture.

We have previously discussed how some communication systems have used an ambiguous underlying metaphor to stimulate the interpretation and reflection on received messages. Using ambiguity compels us to consider how sensory media can be used in this way. Certain senses, such as smell, are ambiguous by nature; it is difficult to conceive of a system which utilised smell for unambiguous communication. Other media, such as text or pictures, have to be adapted to become ambiguous; techniques such as blurring or removing part of the text/image would be necessary to create an ambiguous message. If a designer wants to create an ambiguous communication system, it is logical to consider what type of message they think would be most effective in stimulating interpretation in the desired way.

The selection of which sensory media to use within the device also has an impact on the ability to embed elements of personalisation in the communication system. Some media, such as voice and handwriting, are inherently personal. Other media, such as typed text has limited ability to present personalised elements through the format of the message although personalisation can still be embedded in the device as a whole (for example, embedding a laptop within the covers of a favourite book). It is worth highlighting that touch may be considered a special case of sensory media. Although hugging one person is much like hugging any other person (i.e. there is a relatively low level of personalisation), the act itself is reserved for use with very few people. This in of itself could be considered a form of personalisation.

We have already stated that there are a lack of devices which use intimate co-located behaviours as the metaphor behind their design. Within this thesis, these behaviours will form the underlying metaphor of all of our devices. We discussed in Chapter 2 that many intimate behaviours (such as hugging or kissing) involve some element of touch. This subsequently implies that as we are basing the design of our devices on the metaphor of co-located behaviours it is logical to consider using haptics as the 'sensory medium' when using that metaphor. In the next Section we consider haptics and what is known about using touch as an interaction technique.

In summary, we believe that it is necessary to take a position on each design facet which is meaningful in the context of the other criteria. In the next Chapter we discuss how this is applied in the devices.

2.11 Haptics

We have just established that this thesis will focus on mimicking co-located intimate behaviours as a basis for designing communication technologies for LDDRs. Many intimate behaviours, such as cuddling, holding hands, hugging and kissing all involve some element of touch. Indeed, many of the devices we've analysed which are based on co-located behaviours use touch as their method of interaction. As such, we will briefly consider the relevant work on haptics and it's ability to assist intimate communication.

2.11.1 Embodied Experience

Merleau-Ponty argued that our physical form is the manner in which we learn about the world as the human body is an entity like every other entity in the world [Merleau-Ponty, 1967, Abram,

1997]. To see, one must be visible, to touch, one must be able to be touched [Tripathi, 2005]. If touch is the manner in which we learn about other people, it must also be the method by which other people learn about us. As Merleau-Ponty has argued that our physical embodiment is a source of our knowledge and understanding, haptics and tangible computing remain an area of important research. Devices which take advantage of such a fundamental sense could be immensely powerful in terms of communicating in an intimate fashion.

"The world and the lived body together form an intentional arc which binds the body to the world. This arc anchors us in and to the world. The intentional arc is the knowledge of how to act in a way that 'coheres' with one's environment bringing body and world together" [Turner, 2008a, p. 479]. Turner argues that our intuition about the world and how we interact with it can be framed as an action-perception cycle, highlighting the importance of bodily experience in how we interact with the world. Such a framing indicates that not only could haptic devices hold more emotional meaning, they could also be more intuitive to use.

This may seem an interesting, but irrelevant, philosophical discussion. It is not. This brief discussion highlights the importance of our corporeal beings, the importance of our ability to *touch*. It is this ability which informs the way we operate in the world and that it is impossible to imagine a world without touch. All our experiences are based upon our corporeal existence and thus without this physical body we would not be able to think (as thought is based at some level on experience). The significance of touch indicates that haptic devices could be of use in generating high levels of Social Presence between long distance dating couples.

2.11.2 Touch as an interaction technique within personal relationships

We must be clear that when discussing 'touch' we are primarily talking about physical sensations generated by contact with a physical object such as touch (i.e. pressure) and heat, as distinct from other non-verbal behaviour such as voice tone or body positioning which have their own field of research (e.g. [Mehrabian, 2007, Pease and Pease, 2004]).

As our primary focus is on designing communication technologies we are not interested in the detailed physiology of touch (how the body senses touch) (for example, see [Roberts, 2002, Klatzky and Lederman, 2003]) or the ability to distinguish between different materials using tough interfaces (see [Iwai and Sato, 2005, Jones and Ho, 2008, Jones and Berris, 2003]) or the limits of touch as an interaction technique (for example, see [Wilson et al., 2012a,b, Halvey et al., 2012, 2011, Wilson et al., 2011, Salzer et al., 2007, Glencross et al., 2006, Green, 2002]). This work is interesting and informs the design of our devices in so far as safety is concerned but is not of primary concern within this thesis.

An excellent review on the human interpretation of touch can be found in [Gallace and Spence, 2010]. Within this section we discuss those findings which are most relevant to using touch as an interaction technique within distant couples.

Gulledge and his colleagues used a questionnaire methodology in which they asked college students about their preferences and attitudes regarding different types of romantic physical affection (such as backrubs/massages, caressing/stroking, cuddling/holding, holding hands, hugging, kissing on the lips, and kissing on the face) and relationship satisfaction. They reported that tactile physical affection was highly correlated with overall relationship and partner

satisfaction [Gulledge et al., 2003]. Touch has also been associated with levels of oxytocin, a hormone associated with bonding behaviours (see [Gallace and Spence, 2010] for a review of this work). This highlights the power of touch to reinforce social bonds.

A simple touch can have a much stronger impact than words [Brown and Williamson, 2007]. For example, during periods of distress a hug can convey more comfort than words of sympathy. The intimacy of touch has been linked to our evolutionary development. Monkey grooming is all about the intimacy of massage, contrary to popular belief. The physical stimulation of the skin releases endorphins (chemically related to opiates) in the brain, creating a pleasant experience and a craving to be touched again. Dunbar links this to the importance of touch to humans and the innate intimacy of such acts. Touch can easily spill over into sex, providing an evolutionary based argument as to why touch remains so intimate [Dunbar, 2010]. Hertenstein has observed that people are able to identify emotions based on touch and by observing touches on other people [Hertenstein et al., 2009, 2006].

Nardi [2005] found, through her ethnographic work, that touch played a vital role in connecting work colleagues and bonding them together. Although the research is heavily interpreted given the limited amount of supporting evidence, it does highlight the connection between touch and relationships. Similarly, Kraut et al. [1988] discussed how proximity is necessary to aid in scientific research, partially based on the ability of touch to engender trust.

The 'Phone Booth' experiment helps to demonstrate the ability of touch to help form a connection between strangers. The experimenters left a coin in a phone booth and after people used the booth, asked them for the coin. Those who were touched on the elbow (for around three seconds) were more likely to return the coin than those who were not touched [Kleinke, 1977]. Patterson et al. [1986] showed a similar effect in terms of touch increasing compliance with a request for help.

Touch has also been shown to increase people's positive responses. Fisher et al. [1976] got librarians to alternatively touch/not touch people's palms when returning their library card after checking out a book. The touch lasted for around half a second. People were then questioned as to their affective state. Those who were touched reported higher positive responses than no touch participants. Interestingly, the researchers found that "whether or not the touch was perceived, it generally had a positive effect on the recipient's responses" [Fisher et al., 1976, p. 420]. This suggests that even if the touch was below the perceptible threshold it has an impact on people's emotional system.

Nguyen et al. [1975] investigated the meanings of touch through a self-report questionnaire. As a methodology, this is rather dubious; imagining touches and the meanings drawn from them is not as rigorous as getting people to actually touch one another and then assess their feelings. As such, the specific conclusions drawn about the meanings of various types and locations of touch are unconvincing. However, the general conclusion, that different touches (in type and location) mean different things to different people, is unlikely to be affected by the necessary use of imagination over experience.

The implication of this body of work is that touch is a valuable part of interpersonal relationships and thus would be a suitable medium through which we could support Long Distance Dating Relationships.

Touch is generally assumed to be positive for the recipient to the extent that it does not a)

impose a greater level of intimacy than desired or b) communicate a negative message (e.g. condescending or symbolic of status) [Fisher et al., 1976].

Some work has indicated that touch is a useful medium in virtual environments, used to express both a sense of presence and different emotions [Basdogan et al., 2000, Bailenson et al., 2007, Bailenson and Yee, 2007, 2008, Giannopoulos et al., 2008]. Although this work focusses on tele-presence in shared virtual spaces, it is significant as it indicates that communicating touch between remote locations can engender both a sense of presence and emotions. This is what we intend to do in order to increase the sense of Social Presence within relational communication.

Tsetserukou et al. [2010] took this concept further, constructing a mechanism which analyses both IM messages and actions performed within Second Life, trying to automatically extract the emotions being expressed. These emotions are then communicated to the person they are interacting with through one of six devices – HaptiHeart, HaptiHug, HaptiButterfly, HaptiTickler, HaptiTemper and HaptiShiver. We'll discuss two of these devices to illustrate the nature of the devices. The first, HaptiHug, consists of two artificial hands mounted on a belt which is worn around the waist. When activated, pressure is applied around the waist in a manner akin to being hugged. Secondly, HaptiHeart consists of a heart-shaped necklace, worn around the neck such that it sits over a person's heart. When activated, it creates vibrations in different patterns according to the emotion being communicated. Although the project discusses an interesting combination of technologies, the lack of any evaluation means that we have little indication of it's success. What the devices do is illustrate the possibility of haptic interfaces being used to connect distant couples.

As we have previously seen, a number of devices designed to support LDDRs have already used haptics as the means of interaction. Table A.1 in Appendix A shows 13 devices which use touch as the means of communication.

Smith and MacLean [2007] linked haptics and touch with communicating emotion. Using a very basic, 1D haptic device, dating couples and pairs of strangers could communicate different emotions. Strangers were more comfortable with 'ping-pong' (a more abstract system) compared to couples who were comfortable with 'HandStroke' which mimicked the feeling of a palm stroking across your palm. This study therefore links haptic technology with communicating affect and thus with systems designed to support close relationships.

Brave and Dahley [1997] have argued that "touch is a fundamental aspect of interpersonal communication" when discussing their inTouch device. Heat has been used as an interaction media as it has been associated with emotional communication [Lee and Lim, 2010]. During their design workshops, Mueller et. al. found that their participants "expressed the desire for a tactile or haptic experience when communicating with their partner remotely" [Mueller et al., 2005, p. 1673]. The importance of this work is that haptics has been successfully used to bridge the gap for emotional communication in LDDRs.

Wang and Quek [2010] have proposed "a model of immediacy of the touch channel for conveyance of affect". Their primary design guidelines are that "the touch channel needs to be coupled with other communication channels to clarify its meaning; second, encourage the use [of] touch as an immediate channel by not assigning any symbolic meaning to touch interactions". The second guideline links to our discussion of ambiguity. Touch has no inherent meaning, it's relational value comes from an understanding of the context surrounding the act. A hug can be used for many reasons – to comfort, to express affection, as a greeting – without

the touch having specific meaning. In our devices, the use of touch sits within the framework of behavioural metaphor giving relational meaning to the touch. The first guideline builds on this by arguing that people do not typically communicate simply through hugs and kisses, they want to talk and chat. As such, it makes sense to use our devices alongside other communication channels, using the emotional support of our devices alongside technologies which allow people to talk more generally. This corresponds with how haptics has been used in the devices which we have previously discussed and will be the technique we use throughout this thesis.

2.12 Summary

In this Chapter we have discussed the literature which underpins this thesis. We have covered seven main areas; what relationships are, how LDDRs operate, what Social Presence is and how it may relate to Closeness. We then briefly considered what communication actually means and how it has been modelled for intimate relationships. We also considered how various facets of communication, such as gift-giving, could inform this thesis. We then performed an in-depth analysis of 32 communication devices intended to support LDDRs or other social relationships. By analysing this work we were able to find methodological shortcomings in terms of the lack of evaluation of these devices. Additionally we identified four design facets common across these devices. Finally we have briefly considered touch and demonstrated that haptics have previously been used to create successful devices aimed at supporting LDDRs, especially given the link between touch and relational intimacy. To summarise the key findings of this literature review:

- Relationships are fundamental to being human
- LDDRs are not inherently weaker than GCDRs
- LDDRs focus more upon intimate communication than GCDRs
- We have established some of the methodological points of the thesis, namely that we will:
  - Use University students
  - Measure individuals rather than couples
  - Use a self-definition of distance status
  - Use couples who have been in their relationship for at least six months
  - Use couples who live within the same time zone
- We defined Social Presence as a phenomenological concept referring to 'the degree of salience of the other person in the interaction and the consequent salience of the interpersonal relationship" [Short et al., 1976, p. 65]
- We established that communication media, alongside other concepts, can impact feelings of Social Presence
- We discussed how acts of communication could impact how close people feel towards one another
- That physicality is of significance when discussing Closeness

- We analysed what communication consists of and how it involves not only the exchange of content but the exchange of emotions as well
- We established how idiomatic communication, non-verbal communication and gift-giving could affect the design of our communication devices
- Our analysis of past devices highlighted how few devices have been evaluated. We have stated that we will evaluate, to some extent, each of the devices we develop to overcome this methodological shortcoming
- Of analysis of past devices also highlighted four common facets of design across these devices
  - We discussed how personalisation can be integrated into the design of communication devices
  - We discussed how effortful communication devices could be designed
  - We explained why this thesis will focus on designing devices based on mimicking co-located behaviour
  - We subsequently explained why this thesis will focus on using haptic technology as the means of interaction
- We described how touch is fundamental to being human and how touching one another links to relationships
- Finally we discussed how haptics has been used in the past to help communicate emotion

These findings suggest that it is necessary to address a number of questions before considering the design of communication technologies to support LDDRs. These questions focus on our understanding of Social Presence as a phenomenological concept and whether SP can be used to support LDDRs through the design of communication technologies.

In order to examine the significance of Social Presence and the design of communication technologies to support LDDRs, it is necessary to establish a sound methodological basis for its investigation. The next Chapter builds on the focus of thesis and outlines the broad methodological position of this thesis. Whilst design methodologies could be important for detailed specific approaches to the development of communication technologies, this thesis focusses on articulation of design facets. We discuss this distinction in more detail in Chapter 5. Instead, the next Chapter focusses on describing the study approach used throughout this thesis alongside the qualitative and quantitative techniques we will use to analyse the data gathered to answer our research questions.

Chapter 3

Methodology

Thus far we have introduced long distance dating relationships, described the concept of Social Presence and placed SP within the context of LDDRs. It is now necessary to consider the methodological approach we are going to take with regards to studying Social Presence. A choice of methodology determines what questions you can ask, how you go about answering them, what counts as reliable and valid data and what methods of analysis are appropriate.

Determining our methodology was dominated by two key questions; how to measure Social Presence elicited in episodes of mediated communication and how to adequately preserve the relational context of communication such that measurements of Social Presence are meaningful.

3.1 Study Approach

Our research questions are based in an area of human activity where experimental investigation has little advantage as a methodological technique. There is so much context surrounding each communicative act that isolating them in a lab setting is unlikely to be revealing. Furthermore, an experimental setting would likely be too artificial to reflect the true communication practices of participants whilst introducing unwanted influences due to the unfamiliar setting. Telepresence researchers have also acknowledged the importance of context, particularly when turning a space into a place [Turner et al., 2005]. The relational sphere of human activity is, furthermore, largely about subjective meanings, attitudes and feelings rather than transparent communication activity. Such a position is supported by other work in this area (e.g. [Sedikides et al., 1999, Stafford et al., 2006, Stafford and Reske, 1990, Stafford and Merolla, 2007, Le et al., 2011, Pistole et al., 2010, Dainton and Aylor, 2002, Brown et al., 2009, Kaye and Taylor, 2006, Crabtree et al., 2009]).

As the HCI field has moved away from just considering efficiency and moved to view aesthetic and conceptual pleasure as essential rather than coincidental, measures have been developed to investigate such ideas within field studies. For example, cultural probes are one of the most well known of these techniques. They have been described as "collections of evocative tasks meant to elicit inspirational responses from people... none of these tasks produced returns that were easy to interpret, much less analyze" [Gaver et al., 2004, p. 55]. Rather than producing easily comparable data, the probes are meant to encourage people to tell stories about themselves

that are grounded in their own experiences. We need to discuss cultural probes in order to state why we are not going to use them.

Cultural probes operate by giving participants an interesting collection of material and asking them to answer thought provoking questions. Questions such as "something you'd like to get rid of, something red", alongside other systems such as 'dream recorders' and 'friendship maps', are intended to provoke reflection and articulation of values and practices embedded in everyday life [Gaver et al., 1999, 2004]. Common materials include maps, postcards, cameras, pens, felt-tips and booklets. Participants have a huge amount of leeway in how they use the materials and instructors in how they ask questions.

The value of using cultural probes comes from the rich data they produce. Although the data is hard to analyse in a controlled, statistical manner they produce a good story of how participants operate, use technology, think and feel. Given the evocative, playful nature of the material it is likely that participants will be willing to produce more material than with questionnaires or logbooks. However, this also leads to difficulties in deciding what aspects of the data are important and which are not.

Whilst cultural probes clearly have their place in developing an understanding of existing practices, using them as an evaluation technique is more difficult. The probes are best used in the context of an interview where the probes provide the investigator with material to stimulate discussions. Without the interviewing aspect, the data gathered is extremely difficult to analyse in any meaningful way as it is not clear why a particular response has been provided, nor what that response means to the participant. In that case we would argue that the method used would be better described as a guided interview, a technique we use in Chapter 6.

Part of the reason why measuring Social Presence is challenging is because "intimate acts are ephemeral and transient yet ubiquitous and crucial" [Kjeldskov et al., 2004, p. 102]. A similar argument has been made by [Vetere et al., 2005]. The same is true of Social Presence acts. A researcher investigating the concept through direct intervention (i.e. interviews or observation) is likely to impact upon the transient feelings. This suggests that indirect methods of observing routine communication could be more appropriate when dealing specifically with recording feelings of Social Presence, such that the investigator is having less of an impact on the measurement.

Additionally, Kjeldskov et al. [2004] argue that the informational content of intimate acts is low and thus researchers may not recognise which acts are significant; meanwhile participants may not comment upon it as to them it is obvious what has occurred. The privacy and self-disclosure nature of much of intimate communication also mitigates against direct investigation as participants are unlikely to share such things with the investigators. This again argues for using indirect methods over those whereby the investigator has a significant amount of interaction with the participant and necessitates the careful framing of the study and the treatment of the data.

Having discounted laboratory studies, cultural probes and evaluation methods involving direct intervention, we are thus left with those techniques that do not directly interact with the phenomena under investigation. These include diary studies, questionnaires and interviews, the benefits and drawbacks of which are well known [Lazar et al., 2010].

Questionnaires allow data to be collected from a large number of people at relatively low cost. This is extremely useful when trying to gather a broad overview of a particular concept. How-

ever, this convenience does come at a cost, particularly with regards to collecting shallow data; questionnaire responders tend not to reflect upon their answers and if interesting results are found, it is extremely difficult to ask further follow-up questions. Additionally, questionnaires tend to be completed sometime after the event under consideration occurred.

In many ways, interviews are the antithesis of questionnaires. Suited to probe participants to gather a deep understanding, interviews can gather data which is otherwise difficult to obtain. Follow-up questions can be used to pursue themes which arise during the interview. Interviews can also be exploratory; it is not necessary to need to know what you are looking for before the start of the interview. That is not to say that interviews have no shortcomings. It can be difficult to manage unbounded discussions and, similar to questionnaires, the interview occurs at a time which is distinct from the phenomenon of interest. Additionally, interviews tend to be based around a small number of participants due to the resources required to conduct and analyse a large number of interviews.

Diary studies share some of the drawbacks of questionnaires; participants don't tend to reflect and produce deeply analytical data and can fail to complete sufficient entries. Additionally diary studies require a substantial commitment of time and effort from participants which is difficult to balance against gathering meaningful data. Furthermore diary studies do not supply any contextual information which might assist in analysing the data collected. However, diaries do allow us to collect data in a naturalistic setting which is also temporally valid, that is data which is collected close to the phenomenon under consideration. Diary studies are also necessary for gathering data which changes over time.

As we've seen, none of these indirect data collection techniques are without flaws. However, by being aware of these flaws, these techniques can be used in situations which are appropriate. By using multiple techniques to study a single issue (such as the diary studies and questionnaire used in Chapter 4) we can also triangulate the data, to ensure that our analyses and conclusions are not biased by the flaws of a single technique.

Having selected questionnaires, interviews and diary studies as the study techniques which we will use throughout this thesis, we now need to consider how to measure feelings of Social Presence.

3.2 Evaluating Social Presence

Having discussed the broad methodological approach we will take throughout this thesis, it is necessary to determine how we intend to measure feelings of Social Presence. We have already discussed the theoretical definition of SP in Chapter 2, we now move on to discuss it's operationalisation and the various measures which have been proposed to assess levels of Social Presence.

At the time of writing, evaluating intimate communication systems is relatively under explored and the tools to do it are still in their infancy. The question can be put concisely as "how do we measure whether an end user has been affected emotionally in the way we'd like, by a system? Do we look for physiological evidence of emotions? Do we ask for a self-report of emotional state? If the latter, will traditional questionnaire methods elicit accurate responses?" [Isbister and Höök, 2005]. These are of more relevance if we recognise that in this instance, the same questions exist for measuring feelings of Social Presence.

A major issue for Social Presence research is that "there is, as of yet, no widely accepted measure of Social Presence" [Biocca et al., 2003, p. 19]. That is to say, although there are a variety of measures which have been used to measure feelings of Social Presence, each used by varying numbers of researchers, there is no single measure, no 'gold standard' which is widely accepted as being the most appropriate mechanism for measuring feelings of Social Presence.

There are generally two overarching techniques, either to measure Social Presence as a property of the medium or as a phenomenological state of the user. We have argued that Social Presence should not be viewed exclusively in terms of the medium and is a form of perception of remote parties. Therefore assessment has to be of the user. This can be done either physiologically, in so far as physiological state reflects emotional state, or by questioning users, in so far as users are able to articulate their feelings.

First, let us consider physiological measures. Toups et al. [2006] have created a game whereby physiological signals are integrated into the game and communicated to the team. These signals are processed to form psycho-physiological measures of engagement. We dispute the claim that physiological signals measured from a person's body can be used to accurately infer their psychological state. Taking heart-rate as an example, as it is often used as a convenient, relatively non-intrusive physiological measure; does a high heart-rate indicate anger or excitement? There is a huge psychological difference between the two, and in terms of communication these strikingly different emotions would receive different responses from the communication recipient. All that can be inferred from a heart-rate is how much blood the body currently needs. Indeed, as heart rate differs significantly between individuals, even this is a difficult inference to make. As Blascovitch argued, "a one-to-one correspondence between specific behaviours and unitary physiological responses rarely exist" (quoted from [Biocca et al., 2003]).

In general, physiological measurements give the physical response to an emotion but deriving the cause from the effect is extremely difficult given the small number of possible, measurable outcomes and the large number of psychological states.

Physiological measures also suffer from the three factors that Int [2002] identified:

1. They are hard to collect
2. Awareness of the other may not involve the behaviour, for example an eye fixation
3. The measures are essentially binary, the participant notices or doesn't, whereas co-presence may not be

This analysis thus suggests that we elicit self-report data from the user over using physiological measures. Although the ideal may be to combine the two approaches, (for an example, see [Ståhl et al., 2009]) the lack of easily applicable physiological measures makes this approach difficult to use in practice [IJsselsteijn et al., 2000]. Although several approaches have been taken to self-report feelings, e.g. [Bradley and Lang, 2002], Social Presence has generally been assessed by questionnaires administered after an episode of communication.

It is difficult to select a questionnaire measure of SP. There is a lack of any commonly accepted measure of SP which has two main outcomes. The first is that it is not possible to compare results between research studies as the differing measures are not comparable. The second is

that we cannot be confident that whatever measure is being used is actually measuring the intended concept, i.e. SP.

[van Baren and IJsselsteijn, 2004] presents an excellent review of currently available measures of Social Presence. There is no shortage of measures, they list 12 SP questionnaires alone.

The issue of selecting a measure is more complex than a mere absence of measures. Beyond questions around post-hoc rationalisation, which we shall discuss shortly, not all of the questionnaire details are published making it hard for other researchers to use the same questionnaires. Most suffer from reliability/validity issues. Not least, the questionnaires are either extremely long (e.g. Networked Minds [Biocca et al., 2001] contains 38 questions, the ABC-Questionnaire contains 60 items [van Baren et al., 2004, 2003, IJsselsteijn et al., 2009]), focus on specific CMC technologies (e.g. [Gunawardena and Zittle, 1997]), focus on specific user groups (e.g. children, [Yarosh and Markopoulos, 2010]) or refer to generic forms of presence, including telepresence (e.g. [Basdogan et al., 2000]). It is therefore hard to use any of these measures in an evaluation and be confident in the data gathered.

There are two questionnaires which are (reasonably) commonly used: Semantic Differentials [Short et al., 1976] and Networked Minds [Biocca et al., 2001]. We will use these two questionnaires as case studies to demonstrate the weaknesses of the evaluation tools currently available.

There are two concepts necessary to assess when analysing the use of questionnaires – reliability and validity [Fowler, 2002], [Litwin, 1995]. It is necessary to consider how the proposed measures of Social Presence were validated and tested for reliability.

Short et al. [1976] used Semantic Differentials to measure a medium's ability to support Social Presence. The questionnaire asks participants to rank the medium in terms of nine pairs of diametrically opposed adjectives. Although the original paper from Short et al. is somewhat unclear on the exact selection of adjectives, we are using the measure as used by [Hauber et al., 2006, 2005]. The first weakness of this measurement is the fact that it asks participants to provide a measure of the medium, not of Social Presence. The second weakness in the context of this thesis is that although the Semantic Differentials measure was established based on a wide variety of media, used in a large range of tasks, it has not been developed exclusively for considering the connection between long distance dating relationships. The Semantic Differentials method was tested for reliability by using it with a large number of participants and then statistical testing for consistency using Cronbach's alpha. This showed that the results were consistent. However no validation of the Semantic Differential questionnaire was undertaken beyond noting that the results were consistent with expectations.

The Networked Minds measure [Biocca et al., 2001, Int, 2002] is also based on a questionnaire which asks 38 probing questions related to eight sub-categories hypothesised to be part of Social Presence. These are then scored on a Likert Scale. Networked Minds was checked for consistency in a similar manner to Semantic Differentials – a comparative task carried out by a large number of participants. Those sub-categories which were not consistent with the other categories were removed from the questionnaire. The task used was the Desert Survival Problem and the communication media were face-to-face versus audio-video teleconferencing. The results showed that face-to-face was more Socially Present than the tele-conferencing system. If this hypothesis is accepted then this provides some evidence of validity but it has not been validated for use with any other medium.

Post-hoc rationalisation is a concept which neither of these measures can take into account. Any measurement which occurs after an experiment has taken place suffers from this concept. Rationalisation is the process whereby participants struggle to remember exactly what occurred during the experiment and thus create an idealised mental model of their mental processes. The story that the participants construct to explain their behaviour could bare little resemblance to what actually occurred. The challenge is to determine how much of the story is a valid reflection of their experience. This is a fundamental issue with questionnaires which we can only acknowledge as an inherent weakness but which could relate to the amount of time between the experience and its reporting. Furthermore, affective experiences may not lend themselves to sophisticated verbal expression [Bradley and Lang, 2002]. Simple verbal forms could thus be a more accessible mechanism for self-reporting feelings.

Our analysis has focussed on the weaknesses of the various measures of Social Presence which exist. As our main interests are in communication technologies rather than the development of new SP measures, we need to select the measure which we have the greatest confidence in. As such, we have decided to use the Semantic Differentials measure of Social Presence. Semantic Differentials was selected for three main reasons. The first is that the effort involved in completing the Semantic Differentials measure of SP is minimal compared to other measures. This is necessary for investigations such as ours which are interested in reports of SP over time, necessitating repeated measures. The second reason is the Semantic Differentials measure was the original measure, proposed at the same time as SP as a concept was first proposed [Short et al., 1976]. The final reason is that the measure has been shown to distinguish between feelings of Social Presence across communication technologies [Hauber et al., 2006, 2005, Short et al., 1976]. These three reasons provide us with a minimal sense of confidence that the scale measures Social Presence sufficiently well to use it within this thesis.

3.3 Qualitative Analysis Techniques

Quantitative analysis can only answer certain questions; specifically those concerned with types of information based in quantifiable data. In the context of this thesis, this refers to numerical measures of Social Presence. We have already discussed the validity of various measures of Social Presence and have selected the Semantic Differentials measure as an appropriate measure of SP.

In contrast, qualitative researchers are concerned with any information from which meaning may be inferred. In essence, qualitative methodologies aim to understand concepts that are difficult or impossible to quantify, such as what it's like to experience certain phenomena. Instead of predictions of further conditions, qualitative researchers often aim for understanding participants' ways of making sense of the given phenomenon [Silverman, 2004, Willig, 2008].

The relevance of this is based on the aims of this thesis. At a high level we are trying to support long distance dating relationships through creating technologies which create a high sense of Social Presence. This question is suited to quantitative analysis, using the Semantic Differentials measure as we have already discussed. Additionally we are interested in how to design communication technologies to support LDDRs and the broader impact that such technologies have on the relationship. These questions are more suited to qualitative analysis because they refer to aspects of people's lives which are not easily quantifiable. At this point,

we need to consider the most appropriate qualitative analysis technique to use throughout this thesis.

3.3.1 Qualitative Analysis Approach

The approach taken to study a particular phenomenon is often determined by an individual's take on the historical question of 'what is reality? How do we study it'?

There are three commonly used qualitative analysis techniques, namely Thematic Analysis, Grounded Theory and Interpretative Phenomenological Analysis. We will discuss these approaches in turn, arguing that Thematic Analysis is the most appropriate technique to use within the context of this thesis.

Our discussion of the various analytical techniques are based on a variety of sources, specifically [Smith, 2008, Silverman, 2004, Willig and Stainton-Rogers, 2008, Willig, 2008, Richardson, 1996, Hsieh and Shannon, 2005, Bryman, 2004, Forrester, 2010, Light, 2006]

Thematic Analysis can be applied across a range of theoretical and epistemological approaches, without committing the researcher to a particular position [Braun and Clarke, 2006, Fereday and Muir-Cochrane, 2006, Bryman, 2004, Willig and Stainton-Rogers, 2008]. "Thematic analysis is a method for identifying, analysing, and reporting patterns (themes) within data. It minimally organises and describes your data set in (rich) detail." [Braun and Clarke, 2006, p. 79]. Commonly used, analysis can be reported simply as 'themes emerging from the data' (e.g. [Taylor and Harper, 2002]). Much work which reports itself as Grounded Theory is more accurately described as thematic analysis – the lack of fully formed theory results in a set of procedures for coding data which is very much akin to thematic analysis.

Thematic Analysis is a six-phase process [Braun and Clarke, 2006]:

- Phase 1: Familiarising yourself with your data
- Phase 2: Generating initial codes
- Phase 3: Searching for themes
- Phase 4: Reviewing themes
- Phase 5: Defining and naming themes
- Phase 6: Producing the report

Grounded Theory [Glaser and Strauss, 1967] is one of the most popular approaches to qualitative analysis. Although it has various forms, all are based on inductive strategies. The researcher is meant to begin with no pre-existing theory, expectations or hypothesis. Instead theory is said to emerge from the data. The aim of the approach is not only to describe the topic of study but also to develop adequate theoretical conceptualisations of findings. The researcher continues the process of data gathering until reaching "saturation", the point at which they judge that nothing new is being learnt.

Grounded theory has two main drawbacks for our current purposes. Most grounded theory works have not produced formal theories thus preventing the development of hypotheses that

can be later tested. Usually, the work stops at a prior level of creating rich, conceptual understandings of specific lived human experiences. This rich understanding is essentially achievable through thematic analysis. The second major weakness is the necessity of analysing the data with no expectations. This is the basis of the grounding of the theory in data. However, if the researcher has no expectations, how can they gather the correct data to answer the questions they are interested in? This is one of the areas of disagreement which led to a schism between Strauss and Glaser on the production of a 'grounded theory'.

Interpretative Phenomenological Analysis (IPA) is a qualitative analysis technique aimed at the "detailed examination of individual lived experience and how individuals make sense of that experience" [Willig and Stainton-Rogers, 2008, p. 179]. It is thus suited to investigations of phenomenological concepts which are only defined within an individual's mind. Emotional experiences can only be understood on the level of the individual. In an investigation, we can take multiple interpretations of individual reality, draw out the similarities and present those [Reid et al., 2005].

A major limitation of IPA is the difference between explanation versus description. As we have made clear, IPA is concerned with finding out about people's interpretation of the phenomenon. This comes at a cost - by focussing on the appearance on the phenomenon, we limit our ability to reason about the cause of the phenomenon. It has been argued that if we want to move beyond understanding to explaining the experiences, we need to be aware of the circumstances that led to the experience [Willig, 2008]. As these can lie far beyond in terms of space and time, it is clearly beyond the scope of this thesis to do that for every participant in every study. Finally, given it's focus on emotional phenomena, IPA is limited in it's ability to answer questions beyond this scope. Given the questions which this thesis aims to answer, especially RQ2 which focusses on which design facets are significant when considering the design of communication technologies for LDDRs, IPA does not seem appropriate.

To summarise, thematic analysis provides a structured inductive process of analysing qualitative data in a form similar to Grounded Theory but without the prohibitions of theoretical interests which Grounded Theory typically involves. Arditti and Kauffman [2004] is a good example of this process whereby 'grounded theory' is used to refer to a thematic analysis process.

"All experienced researchers know that there is no perfect method" [Smith, 2008, p. 47] but thematic analysis is sufficient for our purposes.

3.4 Reliability and Validity

Reliability and validity for quantitative measures is to be found in the mathematical models which determine the significant differences between data and the expected results from certain statistical models. What they mean in qualitative terms is much harder to define. As we are using a mixed-model approach, it is important to consider how we can improve upon the reliability and validity of our quantitative analysis by drawing on our qualitative data analysis. This involves considering what is meant be reliable and valid in terms of qualitative data and the techniques used to analyse the data.

3.4.1 Reliability

Reliability can be defined as the degree to which the finding is independent of accidental circumstances of the research [Silverman, 2008]. In other words, would we expect to obtain the same findings if we repeated the study in the same way?

This is of significance for quantitative research as we saw when discussing the measures of Social Presence (see Section 3.2). However, when considering qualitative data, there is some debate as to whether reliability is necessary [Willig, 2008]. Qualitative research is about individuals' experiences in a particular situation; it doesn't aim to measure a particular attribute across a population. By studying the individuals' interpretation of the phenomenon, it is hoped to gain some understanding of the phenomenon rather than something which can be applied reliably across cases.

Harvey Sacks (quoted from [Silverman, 2008]), in one of his lectures described a situation where a car drove up, a teenage woman emerges and runs a few paces before being chased and pulled back into the car by it's other occupants. The point of the story is to highlight how there are several different interpretations of this which subsequently causes an issue for ethnographers. We simply have to accept that "whatever we observe is impregnated by everyday assumptions and categories" [Silverman, 2008, p. 16]. In such a situation, both reliability and validity are questionable concepts based on the analysts understanding of the surrounding context. The best we can hope to achieve is to collect and analyse the data in a well documented manner, systematically highlighting the evidence underpinning our analysis.

3.4.2 Validity

In some ways, validity as a concept in qualitative analysis is mis-termed. Inherent in the method is the interpreters view; the method freely acknowledges that other interpretations are available and that others are free to believe that those interpretations are more correct than the one presented.

We also need to acknowledge the possibility of error or deceit within participant's data which can invalidate the analysis. Beyond acknowledging this possibility, there is little we can do.

Willig [2008] argues that one of the advantages of contextually valid data collection (e.g. in real-life rather than in the lab) means that the interpretation does not need to be extrapolated from the lab; therefore the research has higher ecological validity. This further strengthens the case for not performing experiments within this thesis.

There is a strong argument that qualitative data should not be manufactured but found 'naturally' [Silverman, 2008]. Given that this is not possible given our research area, we must consider what we can do in order to improve the quality of the data we're collecting. Silverman argues that:

- No data are intrinsically unsatisfactory
- No data are untouched by researcher's hands
- Everything depends on how you analyse data rather than the data's source

Accepting that some sources of data are 'better' than others, it is nearly always better to have data than to not have data. As long as appropriate care is take to analyse the data in an appropriate way, the 'unsatisfactory' data can help inform the theories being developed.

There is an excellent summary of the various ways of ensuring validity within qualitative research in [Smith, 2008]. Instead of simply replicating the various discussions within it; we highlight the techniques from the Chapter we have used to assist with ensuring that our qualitative work reaches an appropriate level of validity.

Triangulation Triangulation is a metaphorical term taken from navigation; a location can be determined by using three different reference points. In this context, triangulation means using data from several different people, sources or studies, all concerned with a single phenomenon, to better understand the given phenomenon. A mixed model approach is another way of approaching triangulation, using both qualitative and quantitative data together to investigate the same phenomenon, each describing a different facet of the research question. Turner and Turner have highlighted how important triangulation is within the field of presence research given the contentious nature of the domain [Turner and Turner, 2009]. In this thesis we approach triangulation by using a mixed methods approach; investigating a set of people's views within individual studies and using multiple studies to investigate particular research questions.

However, we should note that we are triangulating amongst a series of self-report methods. Although this helps to provide a certain level of validity, it only provides a level of data triangulation. It is possible to triangulate other parts of the study including the investigator, the theories used to interpret the phenomenon or the methodological approach. These triangulation methods were not deemed to be necessary within the constraints of this thesis although we acknowledge that they would strengthen the claims about validity we could make.

Participant Feedback Participant feedback is based on making findings and analyses accessible to participants such that they can provide feedback on the arguments made. The argument is that if an analysis makes sense to participants it must have at least some validity to them. Although all the analyses of this thesis were circulated to the relevant participants, no feedback was received. This is weakly encouraging, possibly indicating that our participants were content with the conclusions drawn. Participant feedback is also mentioned as a validity technique by [Willig, 2008]. We refelct upon whether encouraging participant feedback helped verify the analyses of this thesis in our conclusions in Chapter 11.

Paper Trail The final recommendation Smith and MacLean [2007] makes is to produce a paper trail available online. This is one method to give other researchers and the public access to the material to avoid questions of falsification or academic collusion. This paper trail essentially consists of all the work that is created to produce the final analysis. The argument for placing such material online is that other's can audit the process gone through to form the conclusion. It also demonstrates a level of confidence in the analysis by making such auditing possible.

We have made this information available online at `http://people.bath.ac.uk/dg216/audit`. All names which appear in the files have been changed. Those documents where anonymization would be too complicated (for example, in the Case Study diaries completed for Part 2 of this thesis) are not included but are available on request. The progression of codes into themes are presented in the appropriate appendix and linked to from the results section within each study.

3.5 Qualitative and Quantitative Statistics

Having discussed the means by which we intend to measure feelings of Social Presence and analyse our quantitative data, it is worth discussing the relationship between qualitative and quantitative statistics and their use within this thesis.

As the terms might suggest, quantitative statistics refer to statistics calculated from numeric data (such as Social Presence scores) whilst qualitative statistics are calculated from non-numeric data which has to be categorised (such as the type of relationships). Additionally we should note that descriptive statistics describe the nature of the data (such as the mean or standard deviation) whilst inferential statistics allow you to draw conclusions from the data (such as whether there is a difference between two sets of data or demonstrating that a series of variables can predict the value of a different variable).

The main use of quantitative statistics within this thesis refer to any data we have collected on Social Presence or Closeness. In Chapter 4 we demonstrate that communication medium, relationship type and relationship distance can predict SP scores. Similarly we also demonstrate that SP scores and relationship type and distance can predict Closeness scores. These are the only use of inferential statistics within the thesis as it is the only data sourced from multiple participants from which we can draw inferential conclusions.

In the case studies presented in Chapter 9 we have three sets of descriptive quantitative statistics, regarding the causes of anomalous SP results, contrasting communication technologies by Social Presence scores and contrasting Closeness scores over the different phases of the study. These have to be descriptive statistics due to the data all coming from a single couple, limiting the conclusions which can be drawn from the data.

It is fair to say that our main use of quantitative statistics is to inform our answers regarding RQ1 (How should we think about Social Presence with regards to close personal relationships?) and part of RQ3 (Do novel designs for devices based on the design facets from RQ2 engender positive feelings of emotional connectedness?).

There are however some aspects of these research questions which are better answered through qualitative statistics. In Chapter 4 we help answer RQ1 by describing our participants in terms of relationship type and distance before going on to outline the number of communication acts undertaken by each relationship type. This gives an initial impression as to what the differences between the different relationships are.

Qualitative statistics are used more extensively in Chapter 6 in outlining our participants' views on various design facets and their preference for one device or another. This helped us to answer RQ2 (What design facets are significant when considering the design of communication technologies for long distance dating relationships?).

In general then we have attempted to select and use the appropriate statistics based on the nature of the data we have and the questions we were attempting to answer.

3.6 Summary

In this Chapter we have discussed the methodological position we intend to take throughout this thesis. We've covered three main areas; whether to use experimental studies, what scale

to use to measure Social Presence and how to analyse any qualitative data collected within the context of this thesis. In summary, we have decided that:

- We will use field studies rather than laboratory experiments as our broad study approach
- We will use the Semantic Differentials measure of Social Presence
- Accepting the shortcomings of many of the measures of Social Presence, we have stated that we will collect qualitative data alongside measures of Social Presence
- We will analyse our qualitative data using a thematic analysis approach
- We discussed how we will try to ensure the validity and reliability of our qualitative analysis

Having discussed the broad methodological position taken by this thesis, it is worthwhile returning to our main research questions. At the end of the last Chapter we noted that no study has systematically analysed the association between relationship type and relationship distance on feelings of Social Presence. Likewise, we noted the lack of studies analysing a large range of communication technologies to determine which design facets assist in creating a sense of SP. We also discussed how supporting Social Presence could have an emotional impact beyond individual acts of communication if it was associated with changes in the longer-term relational concept of Closeness. These three observations all relate to our first research question:

> **RQ1: How should we think about Social Presence with regards to close personal relationships?**

In the next Chapter we present a three-week-long study during which 63 participants reported daily ratings of Closeness, and communication-event ratings of Social Presence. This study assists us in answering the questions we have posed here.

Chapter 4

Exploring Social Presence

Thus far we have discussed some of the challenges surrounding long-distance romantic couples. This grounds our understanding of how such couples can operate and what can be done to help support such couples. As part of this discussion, we have analysed two key concepts from the psychology literature – Social Presence (SP) and Closeness. These concepts are significant as they can help determine, to a certain extent, the success (or lack thereof) of a relationship.

This analysis revealed several questions, of relevance to this thesis, which have not been previously addressed. These questions focus on the impact of relationship type, relationship distance and communication media on ratings of Social Presence and whether ratings of Social Presence can partially predict ratings of Closeness. Within this Chapter we present a study which aims to address these questions. We first discuss the exact Research Questions based on these areas of interest and how they relate to this thesis as a whole. We move on to discuss the methodology used to address these questions, based around a pair of diaries followed up with a questionnaire. It is then necessary to discuss the nature of the results we gathered and establish the statistical validity of our analysis. This analysis demonstrates how communication media, relationship type and relationship distance all have an impact on ratings of Social Presence. It also demonstrates that ratings of Social Presence have an impact on ratings of Closeness. We conclude this Chapter by considering the qualitative results gathered from the questionnaire which aims to establish the facets of communication media which have an impact on why people use particular technologies and how those technologies have an impact on feelings of Social Presence. This analysis suggests that six themes encapsulate the perspectives expressed by our participants, namely time and effort, manageability, personal connection, physicality, fleetingness and responsiveness.

At this point it is worth reiterating some of the points we have previously discussed. Social Presence is formally defined as "the degree of salience of the other person in the interaction and the consequent salience of the inter-personal relationship" [Short et al., 1976, p. 65] and is a phenomenological construct owing to "whole constellations of cues" [Short et al., 1976, p. 157]. Thus we treat SP in technologically mediated personal relationships as something constructed in the mind of an individual whilst interacting with the representations the other has crafted with the communication medium. That is, through their use of the medium and, critically, given each individual's understanding of the status of their ongoing relationship, the distant other performs actions that evoke a sense of themselves for their loved-one. SP functions by

highlighting the relationship with the other person in the mind of each interlocutor through the acts of communication they share. In the context of personal relationships, we argue that SP corresponds to the level of emotional connectedness each person experiences through acts of communication.

We should note that we conceptualise Social Presence as a short term phenomenon which occurs during a single act of communication. This necessitates collecting Social Presence as soon after the act of communication as is reasonably possible. This contrasts with our conceptualisation of Closeness which we consider to be a longer term phenomenon, realised at various times of day when the other person is brought to mind, resulting in a sense of 'daily Closeness'. This describes the overall feeling of Closeness experienced towards the other person over the day as a whole, smoothed from the fluctuations which occur based on specific acts of behaviour or communication. The two concepts together can be thought of as the sense of emotional connectedness experienced between two individuals, both during specific acts of communication but also across the relationship as a whole.

Closeness, like presence, has a familiar informal meaning. It has also been the subject of extensive research in social psychology and so can be considered in a more restricted sense and in a manner that is quite distinct from the Social Presence construct. It has been defined as a multidimensional construct consisting of frequency of contact, diversity of contact and the strength of contact [Aron et al., 1992]. Closeness is also defined in terms of interdependence [Adams et al., 2001, Berscheid et al., 1989a, Kelley et al., 1983] and self-disclosure [Golish, 2000, Sedikides et al., 1999]. While the exact definition of Closeness varies, three key elements consistently underpin the different conceptualisations of Closeness. The first is that Closeness is an inherent property of interpersonal relationships, being used to distinguish between different types of relationships [Dunbar, 2010]. The second is that communication acts are acknowledged to influence feelings of Closeness [Altman and Taylor, 1973]. Finally, Closeness is a longer-term relational concept than Social Presence: "social bonds do not grow and then stabilize forever. Some reach plateaus and the grow further; others become undesirable and either break-up or revert to an earlier level of intimacy of exchange" [Altman and Taylor, 1973, p. 4]. All friends, at some point, started off as being strangers; unfortunately, some will also finish up that way. Measurements of Closeness have even been demonstrated to be predictive of the break-up of romantic couples [Berscheid et al., 1989a].

From a design perspective, SP is particularly interesting as it is associated with communication media, which are easier to redesign than social structures or economics (i.e. reducing the number of long-distance couples by creating equally 'good' job opportunities all over the country).

As discussed in Chapter 2, relatively little work has been done to examine Social Presence in the context of the role relationship type and relationship distance have in creating emotionally engaging experiences. This Chapter aims to address this confusion by undertaking a study which analyses some of the important factors of SP when considering how to help support long-distance romantic couples. Our exploratory study aims to address RQ1 we identified in the introduction to this thesis:

RQ1: How should we think about Social Presence with regards to close personal relationships?

4.1 Methodology

4.1.1 Research Questions

We have already made clear that the scope of this thesis is limited to considering long-distance romantic couples. What we do not know with any certainty is whether this relationship type differs from other types of relationship (namely friendship, parental or sibling) or distances (co-located or long-distance) in terms of SP and if so, in what way? Within the study reported in this Chapter, the term "co-located" was used instead of Geographically Close Dating Relationships (GCDRs) although the same self-identification criterion was used. This leads to the first two research questions:

- **RQ1.1: Do Romantic relationships differ from other relationship types in terms of SP ratings?**
- **RQ1.2: Does the Distance-status of a relationship impact ratings of SP?**

Determining the strength of SP amongst different relationship types allows us to draw interpretations on the role of SP within those relationships and thus whether it is a suitable concept to use when trying to support that particular relationship type and distance.

We have already discussed at length the historic approach to SP which focussed too much upon the impact of communication media. This is not to say that we do not believe that media has an impact; they clearly do.

From a design perspective, the issue at stake here is how the use of a medium in a long distance relationship contributes to the communicator's experience of SP. We wish to address questions that concern how a communication medium might factor into the instantaneous experience of SP, given a particular 'task context' that is inherently relational: maintaining a relationship. The complexity of the impact that media have on relationships might perhaps be better understood as a set of facets of the communication system (such as synchrony or effortfulness) but such an idea could only be explored with better methods and measures of understanding the relational communication experience. What we do have the ability to do is to contrast media with regards to ratings of SP and then try to find similarities between the facets of high-ranked media and the low-ranked media. These similarities would provide a starting place for understanding what facets we need to support to create communication technologies which help to create communicative acts with high levels of SP. Our third research question is thus:

- **RQ1.3: Does the type of Communication Media have an impact on ratings of SP?**

It is important to note that RQ1.1, RQ1.2 and RQ1.3 all refer to facets of SP measurement. In addition to the 3 key factors (relationship type, relationship distance and communication media), we want to establish how these factors interact together in terms of their impact on feelings of SP.

The ultimate aim of this thesis is to help support long-distance dating relationships. We have selected Social Presence as a suitable phenomenological construct through which to try and

achieve this aim. SP is associated with short-term emotional experiences and is something which can be manipulated through the design of appropriate technology. What is unknown is whether supporting SP has any longer-term benefits beyond the act of communication it is associated with.

In this Chapter we will investigate whether ratings of SP can predict ratings of Closeness, measured on a daily basis. Such an association would suggest a model whereby each act of communication has an impact, to the extent that it generates a sense of SP, on the longer-term feeling of Closeness. We argue that such an association could be detected by finding an association between the ratings of SP and Closeness (measured over different time periods) using an appropriate regression method. Our final research question is:

- **RQ1.4: Do SP ratings predict feelings of Closeness?**

Such a model is interesting from a theoretical perspective and useful from a practical perspective. Modelling SP and Closeness in this way helps broaden our understanding of both concepts in the context of personal relationships. By relating the two concepts to each other, we can demonstrate that by creating technologies which help to create emotionally significant experiences during acts of communication, designers have the potential to help support personal relationships in a more meaningful, long-term fashion. Practically, our model encourages the use of SP as a measurement technique within a Closeness context. If technologies can be associated with high or low levels of SP, then we can make plausible claims about the technology's impact on the relationship's feelings of Closeness, and subsequently the state of the relationship more generally. If SP has a positive association with Closeness, it further validates our choice to use it as the concept to support in long-distance relationships.

Having presented the studies' research questions, we move on to discuss the study methodology constructed to address these questions.

4.1.2 Participants

Participants were recruited through emails and posters on a British university campus. Participants were individuals from the relationship in question. The relationships participants reported on were romantic, friendship, parental and sibling. Table 4.1 shows the breakdown of participants by relationship type and relationship distance. 63 people took part in the study, each reporting on a relationship with an individual not taking part in the study. Participants received no incentive for taking part in the study. Participants had to have been in that relationship for at least 6 months prior to the study.

Relationship Type	**Number of Participants**	**Number of Same-City Relationships**	**Number of Distant Relationships**
Partner	16	6	10
Friend	16	7	9
Sibling	11	1	10
Parent	20	2	18

Table 4.1: Number of participants by separation and relationship

4.1.3 Data Collection

We chose to construct a longitudinal study around diary-based self-report activity from people who we asked to reflect on their communications with 'a person you feel close to'. The study required participants to keep two different diaries, each using a different sampling method to account for the temporal differences in feelings of Social Presence and Closeness we've previously discussed. As we want to investigate changes in Closeness over time, and Closeness is conceptualized as a slow-changing feeling, we adopted a periodic self-report method. This first diary was completed early in the morning every day and consisted of a single measure of Closeness. This was known as the Daily Diary. Participants were instructed that:

> "This diary is intended to be a daily record of how close you feel to your study partner. At around the same time each day, preferably early in the morning, circle the diagram which best represents how close you feel to your study partner. The circles labelled 'self', refer to you. The circles labelled 'other' refer to your study partner."

The second diary was event-based; it was completed each time the participant had communication with their partner. This was called the Contact Diary. Participants were asked to complete their diary as soon after a communication event as was practicable. Each entry recorded basic information about the communicative act including date and time, length and method of communication and who initiated and ended the Contact. Participants were also asked to complete a measure of Social Presence. Participants were instructed that:

> "This diary is intended as a record of all the communication you have had with your study partner. Every time you communicate with your study partner please fill in a new record. The first part of each record consists of some simple questions about the contact. There are then 9 items where you have to indicate which word best describes the contact (and by how much)."

Participants were asked to keep the diaries continuously for a period of 21 days.

4.1.4 Measures of SP and Closeness

The measure of Closeness was the Inclusion of Other in the Self (IOS) scale (see Figure 4.1, and [Agnew et al., 2004, Aron et al., 1992]) which has been used in other studies (e.g. [Van Horn et al., 1997]). This operates in a manner akin to a graphical Likert scale, in that participants are asked to express their reaction to a question on a seven-point scale but each point on the scale is represented by an image rather than a number in a linear sequence. The question in IOS is 'Please circle the picture below which best describes your relationship with your partner' where partner relates to the study partner. IOS represents points on this scale as seven pairs of circles, each labelled 'self' and 'other'. At one extreme - corresponding to 'not at all close' – shows self and other as two circles that abut to one another but do not intersect. At the other extreme, the circles overlap almost completely, the non-intersecting portions thus representing only a small fraction of the individual selves preserved outside of the relationship. The five other points in between thus vary in the degree to which respondents are able to express their

relationship in terms of the proportion of themselves that is comprised of the other. Each pairing of circles has the same area to control for the potential influence of size. Each score was thus between 1 (minimum Closeness) and 7 (maximum Closeness). As a graphical rather than text-based scale, it reflects similar concerns to those that motivated the development of the Self Assessment Manikin to evaluate affective experience including the effort involved in completing the measure and the ability to comprehend the measure [Bradley and Lang, 2002].

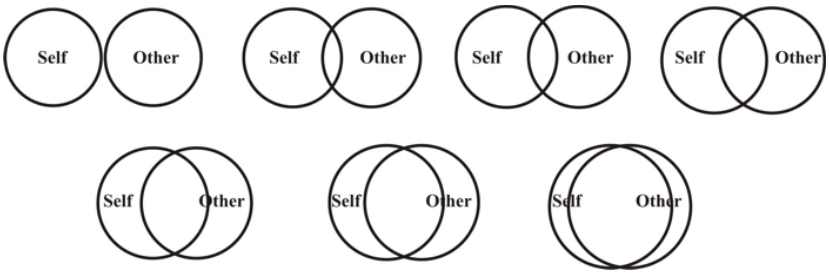

Figure 4.1: The IOS Closeness Measure

As discussed in Section 3.2, a major issue with SP is selecting a measure because researchers have adapted a wide variety of instruments (see [van Baren and IJsselsteijn, 2004]). It is difficult to compare results between studies without standardisation: each questionnaire might be exposing different aspects of the intended phenomenon or miss it altogether. Not all questionnaire details are published and many suffer from reliability/validity issues. Additionally, the questionnaires can be extremely long (Networked Minds [Biocca et al., 2001, Int, 2002] contains 40 questions) or so focused on a specific technology that they are not readily transferable into different studies.

Short, Williams and Christie's semantic differential scales do not suffer from these shortcomings. They contain nine diametrically opposed adjectives (see Table 4.2 and [Short et al., 1976]). Ratings are made on a seven point Likert scale from 3 (near one adjective) through to 3 (near the other adjective). These are then counted as being between 1 and 7 before being summed to give a single measured response.

	3	2	1	0	1	2	3	
Impersonal								Personal
Cold								Warm
Ugly								Beautiful
Small								Large
Insensitive								Sensitive
Colourless								Colourful
Unsociable								Sociable
Closed								Open
Passive								Active

Table 4.2: The Semantic Differentials Measure of Social Presence

The meaning of the differentials focuses on the medium (e.g. 'Skype VOIP is impersonal vs. personal') and so are implicit in the way they evoke the sense of the other person [Biocca et al., 2003]. The scales' use of nine pairs means that the burden of completing the SP ratings is small – an important element of a longitudinal study that seeks to record assessment close to

the relevant event. In this study we report each individual score as a sum of a participant's ratings of the nine semantic differential items (max score was thus $9 * 7 = 63$, minimum was $9 * 1 = 9$).

4.1.5 Ethics

We are working in an area where it is particularly important to consider the ethical implications of our study. Included in Appendix B.1 are the consent forms and ethical checklist used to ensure that the study was conducted in an appropriate fashion. Both forms were checked by the ethics officer within the Department.

To briefly run through the main concerns; the study included no hidden procedures and no deception was involved. Participants were informed about the data being collected and it was made clear that it would be recorded anonymously and could not be traced back to the individual. It was also made clear that the data would not be passed to any third party (including their partner) and were not being collected for commercial reasons. However, participants were warned that the results of the study may be published in an anonymous form.

It was made clear in the consent form that participation in this study did not involve physical or mental risks outside of those encountered in everyday life. Most importantly, it was made clear that participants had the right to withdraw from the study at any time. Informed consent was taken from each participant.

4.2 Results and Analysis

Our 63 participants returned a total of 922 Contact Diary entries, each comprising of a set of Semantic Differential ratings of SP for that particular contact episode and short descriptions of who was involved, what they discussed and who initiated and ended the exchange. 63 Daily Diaries were returned, each comprising a single IOS rating to reflect their feeling about the other person at the start of each day. This results in 1323 individual Daily Closeness ratings. Two participant's diaries were rejected as each measure was consistently rated at its maximum. Both participants were reporting on their long-distance romantic relationships. This was deemed as being indicative of a lack of reflection and as such likely to negatively impact the validity of any statistical test which used this data. After data cleaning (discussed in Section 4.4), we are analysing 882 contact reports and 1281 Daily Closeness ratings.

Relationship Type	**Mean Number of Contact Entries (*SD*)**	**Mean Number of Same-City Contact Entries (*SD*)**	**Mean Number of Distant Contact Entries (*SD*)**
Partner	25.1 *(13.1)*	30.8 *(13.9)*	20.8 *(11.5)*
Friend	14.8 *(5.3)*	16.4 *(5.5)*	13.6 *(5.0)*
Sibling	6.3 *(2.7)*	7.0 *(-)*	6.2 *(2.9)*
Parent	11.3 *(8.7)*	14.5 *(2.1)*	10.9 *(9.1)*

Table 4.3: Number of Contact Diary entries by distance and relationship

The mean number of Contact Diary entries returned by our participants was 14.5, SD was 10.6, median 13.0. The maximum for any one individual was 58, the minimum was 0. Perhaps unsurprisingly, there was considerable variation between relationship type and distance (see Table 4.3). An initial interpretation of this data shows that Romantic Partners tend to communicate more often than other relationship types and that co-located people communicate more than people living at a distance.

The diary pages included an initial set of communication technologies consisting of Face to Face, Instant Messenger, SMS, Telephone, Skype (voice only), Skype (with video), Email and Letter. We included an "other" category such that the classification of technologies was not pre-determined but reflective of what our participants actually use. Additional technologies our participants used included Facebook, Cards and MMS.

Tables 4.4 through 4.6 show the mean and standard deviation for our contact SP scores by relationship type, relationship distance and communication media respectively. Tables 4.7 and 4.8 show the mean and standard deviation for our Daily Closeness scores by relationship type and relationship distance. This information is presented to inform our interpretation of our statistical analysis.

Relationship Type	**Total Number of Communication Acts**	**Mean Contact SP Score *(SD)***
Partner	351	48.00 *(10.06)*
Friend	237	48.05 *(8.02)*
Sibling	225	46.43 *(7.33)*
Parent	69	43.43 *(7.67)*

Table 4.4: Mean and Standard Deviations of Contact Social Presence scores for each type of relationship

Relationship Distance	**Total Number of Communication Acts**	**Mean Contact SP Score *(SD)***
Distant	546	47.70 *(8.46)*
Co-located	336	46.53 *(9.28)*

Table 4.5: Mean and Standard Deviations of Contact Social Presence scores for each distance of relationship

Before discussing the depth, we first consider the statistical validity of any tests we perform on the data we have collected.

4.2.1 Statistical Validity

Our 882 contact reports and 1281 Daily Closeness ratings represent our entire data sample. It is necessary to describe some of the features of this data set in order to establish the most appropriate statistical test to use to analyse any variation within the data[1]. The first feature to

[1]At this point it is appropriate for us to acknowledge the contribution of and thank Alex Griffiths for her assistance in ensuring the statistical validity of this Chapter. As a PhD. student in statistics, Alex runs the Statistics Advisory Service at the University of Bath and was kind enough to first help us in selecting an appropriate statistical treatment for our data and secondly to read over this Chapter to check that the results are reported accurately. We are deeply grateful for her assistance.

Communication Media	**Total Number of Communication Acts**	**Mean Contact SP Score *(SD)***
Face to Face	209	51.52 *(8.81)*
SMS	240	43.44 *(7.59)*
Telephone	176	47.51 *(8.55)*
IM	63	45.84 *(8.02)*
Email	88	44.14 *(7.86)*
Skype (with video)	76	53.08 *(7.04)*
Skype (voice only)	16	45.50 *(6.00)*
Facebook	8	40.75 *(2.82)*
Letter	3	48.33 *(2.31)*
Card	1	51.00 *(-)*
MMS	2	33.00 *(7.07)*

Table 4.6: Mean and Standard Deviations of Contact Social Presence scores for each type of communication media

Relationship Type	**Total Number of Communication Acts**	**Mean Contact Closeness Score *(SD)***
Partner	294	4.72 *(1.49)*
Friend	336	6.22 *(9.64)*
Sibling	231	3.35 *(1.45)*
Parent	420	4.44 *(1.51)*

Table 4.7: Mean and Standard Deviations of Daily Closeness scores for each type of relationship

Relationship Distance	**Total Number of Communication Acts**	**Mean Contact Closeness Score *(SD)***
Distant	945	4.88 *(5.96)*
Co-located	336	4.48 *(1.56)*

Table 4.8: Mean and Standard Deviations of Daily Closeness scores for each distance of relationship

note is that the study design results in a data set which is inherently repeatedly measuring the same people. In addition to this repetition of recording, the data is also hierarchical [Nezlek, 2001, 2003]. We have ratings from multiple people, reporting on multiple days, each of which can contain multiple acts of communication. Our variety of variables are measured across these different levels – importantly, relationship type and relationship distance are at a person level, ratings of Closeness are at a daily level and finally ratings of SP and type of communication media are at a the level of a single act of communication. The lack of independence between our contact reports, as well as the differing levels at which our data is measured, will have to be accounted for in any statistical test.

Table 4.9 shows the level of measurement for our variables of interest. This is a good starting point for selecting an appropriate statistical treatment.

Research questions RQ1.1, RQ1.2 and RQ1.3 refer to predicting SP values. Although the SP scale is ordinal, the high number of categories the variable can take (between 9 and 63), means

Variable	Level of Measurement
Relationship Type	Categorical
Relationship Distance	Binary
Communication Media	Categorical
SP Rating	Ordinal (nearing continuous)
Closeness Rating	Ordinal

Table 4.9: Level of measurement for each variable

that an ordinal regression would not be appropriate. We can instead assume that the SP scale resembles a continuous distribution [Pasta, 2009]. This means that these research questions (RQ1.1, RQ1.2 and RQ1.3) can be analysed using a repeated measures linear regression. There are four assumptions to meet to make such a regression valid [Nay, Accessed December 2012, Cohen et al., 2003]. These assumptions are:

1. linearity of the relationship between dependent and independent variables
2. independence of the errors (no serial correlation)
3. homoscedasticity (constant variance) of the errors
4. normality of the error distribution.

Appendix B.2 details how our data set meets these assumptions.

RQ1.4 refers to whether SP ratings (or other factors) can predict feelings of Closeness. The Closeness scale is an ordinal measure with a low number of categories. This means that a repeated measures ordinal logistic regression is appropriate. The assumptions of this test are discussed in Appendix B.2.

4.2.2 Which factors can predict participants' SP ratings?

Our first three research questions (RQ1.1, RQ1.2 and RQ1.3) refer to whether relationship type, relationship distance and communication media can predict participant's Contact SP ratings. We've already discussed how a repeated measures linear regression is suitable to analyse these questions.

It is possible to construct multiple models of linear regression which use different combinations of the parameters to predict the response variable. In our case, the response variable is Social Presence and the predictor parameters are relationship type, relationship distance and communication media. Table B.1 in Appendix B.3 shows how the different parameters can be used to model the Social Presence score, alongside a measure of how closely the model fits the data (the Corrected Quasi Likelihood under Independence Model Criterion). Two models were selected as having the lowest score, indicating that the model predicts more of the variation in the data set and illustrate different facets of our research question.

Model One: Communication Media and Relationship Type × Relationship Distance

The first model considers relationship type × relationship distance alongside Communication Media. This allows us to consider the impact of these two factors independently of one another. What this means is that we can assess the impact of communication media independently from the impact of relationship type × relationship distance. The '×' between relationship type and relationship distance combines those two parameters into a single parameter. This is done as combined the parameter predicts more of the variance in the data than each would individually. For example, the effect is likely to be different for comparing 'distant partners' than 'distant' and 'partners' separately.

At this point it is necessary to briefly discuss how linear regression works such that our analysis can be meaningfully interpreted. We can disregard the repeated measures aspect of the test in this description as it is not meaningful to interpreting the results. Linear Regression is a statistical approach where a value, Y, is predicted by a linear function on a series of parameters, $\beta_1 X_1 + \beta_2 X_2$, plus an error term α that describes the variation of the real data above and below the predicted line. We thus get an equation in the form:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2$$

To take our first model, presented in Table 4.10, our value being predicted, Y, is Social Presence. The predictor variables, X_1 and X_2 are communication technology and relationship type × relationship distance respectively. β_1 and β_2 are the values which we are looking for, those which are used to predict the impact of a given communication technology or relationship type × distance on Social Presence scores.

There are a number of elements of the model which need explaining. In regression using categorical parameters, we have a 'comparison category', a value of the parameters against which other values are compared. In our model, the comparison category for relationship type × relationship distance is co-located partners and for communication media it is face-to-face communication. The intercept represents the predicted SP score for an act of communication for co-located partner's talking face-to-face.

The set of parameters are associated with the change in SP (B) we would expect if that parameter was changed to that value. For example, if we consider predicting the SP rating of a telephone call between co-located partner's you would expect a rating of 51.93 (the intercept) + -6.87 (the value of B) = 45.06. If predicted a face to face conversation between distant partner's you would predict a SP rating of 51.93 + 5.01 = 56.94. It is important to note that these changes operate independently of one another; a change from face-to-face to telephone is always predicted to change the SP score by -6.87 regardless or the relationship type x relationship distance under discussion. Likewise, a change from co-located partners to distant partners is always predicted to change the SP score by 5.01 regardless of the communication medium being used.

The significance column (sig) shows whether a given parameter is considered to be significantly different from the intercept. Within this Chapter we consider anything below 0.05% to be significantly different from the intercept. It is not necessary to perform a multiple comparison correction (such as Bonferroni) as as you are comparing multiple levels of a categorical variable (essentially a single test) rather than performing multiple tests.

The regression model indicates that relationship x distance (wald chi-square(7) = 136.483, $p < 0.001$) and communication media (wald chi-square(10) = 3519.202, $p < 0.001$) are significant predictors of Contact SP ratings. The Intercept of this model is wald chi-square(1) = 3150.848, $p < 0.001$. This means that there is strong evidence to suggest that relationship type x relationship distance and communication media can predict ratings of Social Presence. Table 4.10 shows the details of the regression model.

			95% Wald Confidence Interval		**Hypothesis Test**		
Parameter	**B**	**Std. Error**	**Lower**	**Upper**	**Wald Chi-Square**	**df**	**sig**
(Intercept)	51.93	1.49	49.00	54.86	1208.56	1	0.001
Friend x Distant	4.37	2.20	0.05	8.68	3.93	1	0.047
Friend x Co-located	1.11	2.19	-3.17	5.40	0.26	1	0.611
Sibling x Distant	0.01	2.08	-4.07	4.08	0.00	1	0.998
Sibling x Co-located	-5.12	1.29	-7.64	-2.60	15.84	1	0.001
Parent x Distant	1.85	1.70	-1.48	5.19	1.20	1	0.275
Parent x Co-located	-3.38	5.32	-13.82	7.05	0.40	1	0.525
Partner x Distant	5.01	2.06	0.97	9.05	5.90	1	0.015
Partner x Co-Located	Comparison category						
SMS	-10.07	1.15	-12.32	-7.83	77.14	1	0.001
Telephone	-6.87	1.29	-9.41	-4.34	28.35	1	0.001
IM	-10.54	1.35	-13.18	-7.90	61.20	1	0.001
Email	-10.70	1.72	-14.07	-7.33	38.68	1	0.001
Skype (with video)	-5.38	1.56	-8.43	-2.33	11.93	1	0.001
Skype (voice only)	-7.08	1.29	-9.61	-4.54	29.94	1	0.001
Facebook	-13.93	2.69	-19.19	-8.65	26.80	1	0.001
Letter	-7.38	1.96	-11.21	-3.54	14.23	1	0.001
Card	-5.23	1.26	-7.70	-2.77	17.27	1	0.001
MMS	-17.56	1.34	-20.19	-14.93	170.88	1	0.001
Face to Face	Comparison category						

Table 4.10: Parameter Estimates from the first repeated measures linear regression model

Table 4.10 shows some interesting results. Firstly, all communication media are rated as being significantly lower than Face to Face communication, indicating the importance of this form of communication in personally meaningful relationships. Many prior investigations (see Section 2.4) have contrasted communication media through SP ratings in laboratory experiments. Our data, taken from a longitudinal setting, show similar differences.

Deepening our analysis, there appears to be a division between a set of high SP technologies (namely Telephones and both versions of Skype) and a set of low SP technologies (namely SMS, IM, Email and Facebook). Although all of these technologies predict lower SP scores than face to face, they vary in how much lower their predicted SP score is. Letters, cards and MMS messages were excluded from this deeper analysis given their low rate of occurrence.

One of the reasons for analysing the impact of communication media on SP was to analyse what set of facets of a communication system could have an impact on the feeling of SP during an act of communication. However the distinction between these two sets of technologies is

difficult to determine. The high SP set contains technologies which use an element of people's person-hood (predominantly their voice) whereas the low SP set does not contain such personal elements. All of the low SP technologies are text based. Additionally, the majority of the low SP technologies (excepting IM) are asynchronous whereas all of the high SP technologies are synchronous. As a final observation, all of the high SP technologies produce acts of communication which are fleeting while the low SP technologies involve the exchange of more 'realised' or permanent messages. Both person-hood and fleetingness were noted as being important aspects of communication in qualitative aspect of this study (see Section 4.3). These observations will be explored further in our initial design space presented in Section 5.4 (which includes personalisation, sensory medium and fleetingness) and in the revised design space presented in Section 6.4 (which includes synchrony).

Three relationships were found to statistically predict different SP scores to co-located partners. Co-located siblings are predicted to have a lower SP score than co-located partners. This might be expected, given that partners require more emotionally meaningful communication in order to sustain their relationship [Stafford, 2010] which we assume is closer than sibling relationships [Dunbar, 2010].

Of most interest is the fact that distant partners are predicted to have a significantly higher SP score than co-located partners. This is perhaps unsurprising; in distant relationships communication technologies are the primary means of communication. This is likely to increase the emotional meaning of these technologies compared to co-located relationships. Similarly, the limited opportunities for face to face communication in distant relationships is likely to increase its meaning when it does occur.

It is harder to explain the higher SP score predicted for distant friends. Two possible interpretations are as follows. The first concerns the nature of the friendship. Most friendships are made when the friends are co-located. It is feasible that many of these relationships only became distant when our participants moved away to University. If that is the case, it is plausible that our participants are trying to maintain the bond of their co-located relationship through the use of communication technologies – this would account for the high level of SP they experienced during their acts of communication.

An alternative interpretation is based on a similar interpretation as to the high SP score of distant partners. In any distant friendship communication technologies are the primary means of communication. Distant friends are still predicted to have a lower SP score than distant lovers. It could be that the simple act of being apart imbues technologies with more importance, overriding the lesser degree of closeness typically experienced between friends compared to partners. This could explain why distant friends are predicted to report higher levels of SP than co-located partners but not as high as distant partners. However, friendship relationships are not the focus of this thesis and the study provides no data to assess such a claim.

Model Two: Communication Media x Relationship Type x Relationship Distance

In principle, people may have different experiences of communication through media depending on the relationship they have with the other person. As such, we wanted to analyse whether different relationship types and distances had particularly different SP ratings for particular communication media within the context of personal relationships. This is what the second

model considers; whether relationship type x relationship distance x communication media can predict feelings of SP. This allows us to consider the impact of communication media within distant and co-located partner relationships.

The regression model indicates that relationship x distance x communication media (wald chi-square(35) = 21029.573, $p < 0.001$) is a significant predictor of Contact SP ratings. The Intercept of this model is wald chi-square(1) = 6674.800, $p < 0.001$. This means that there is strong evidence to suggest that relationship type x relationship distance x communication media can predict ratings of Social Presence. Table 4.11 shows the details of the regression model.

			95% Wald Confidence Interval		**Hypothesis Test**		
Parameter	**B**	**Std. Error**	**Lower**	**Upper**	**Wald Chi-Square**	**df**	**sig**
(Intercept)	52.38	1.36	49.72	55.04	1486.40	1	0.001
Partner x Distant x SMS [1]	-5.68	2.33	-10.25	-1.11	5.94	1	0.015
Partner x Co-located x SMS [2]	-9.59	1.34	-12.22	-6.96	51.09	1	0.001
Partner x Distant x Telephone	-4.06	2.93	-9.80	1.68	1.92	1	0.166
Partner x Co-located x Telephone	-7.23	0.96	-9.10	-5.35	57.11	1	0.001
Partner x Distant x IM [3]	-6.14	1.92	-9.91	-2.38	10.22	1	0.001
Partner x Co-located x IM [4]	-13.71	0.76	-15.19	-12.23	329.40	1	0.001
Partner x Distant x Email	-11.86	3.50	-18.73	-4.99	11.48	1	0.001
Partner x Co-located x Email	-18.05	5.07	-27.98	-8.12	12.69	1	0.001
Partner x Distant x Video Skype	-0.98	2.43	-5.74	3.78	0.16	1	0.687
Partner x Distant x Face to Face	11.24	1.98	7.36	15.11	32.31	1	0.001
Friend x Distant x SMS	-7.54	2.03	-11.52	-3.56	13.79	1	0.001
Friend x Co-located x SMS	-7.47	2.53	-12.43	-2.50	8.69	1	0.003
Friend x Distant x Telephone	0.92	2.81	-4.58	6.42	0.11	1	0.743
Friend x Co-located x Telephone	-4.19	2.99	-10.04	1.67	1.97	1	0.161
Friend x Distant x IM	-5.59	1.93	-9.37	-1.81	8.41	1	0.004
Friend x Co-located x IM	-9.09	3.49	-15.93	-2.24	6.77	1	0.009
Friend x Distant x Email	-4.70	2.49	-9.59	0.19	3.55	1	0.060
Friend x Co-located x Email	-1.53	3.27	-7.95	4.88	0.22	1	0.640
Friend x Distant x Video Skype	-0.04	2.43	-4.81	4.73	0.00	1	0.986
Friend x Co-located x Video Skype	-1.00	2.24	-5.38	3.38	0.20	1	0.655
Friend x Distant x Facebook	-11.95	1.36	-14.61	-9.29	77.38	1	0.001
Friend x Distant x Face to Face	0.05	2.83	-5.49	5.59	0.00	1	0.986
Friend x Co-located x Face to Face	-1.71	2.62	-6.84	3.41	0.43	1	0.513
Sibling x Distant x SMS	-11.19	2.87	-16.82	-5.55	15.16	1	0.001
Sibling x Co-located x SMS	-18.38	1.36	-21.04	-15.72	183.01	1	0.001
Sibling x Distant x Telephone	-7.28	2.45	-12.07	-2.48	8.85	1	0.003
Sibling x Distant x IM	-10.90	2.23	-15.27	-6.53	23.87	1	0.001

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Table 4.11 – continued from previous page

			95% Wald Confidence Interval		Hypothesis Test		
Parameter	**B**	**Std. Error**	**Lower**	**Upper**	**Wald Chi-Square**	**df**	**sig**
Sibling x Distant x Email	-12.40	4.40	-21.02	-3.78	7.95	1	0.005
Sibling x Co-located x Email	-13.38	1.36	-16.04	-10.72	96.98	1	0.001
Sibling x Distant x Video Skype	1.85	1.86	-1.79	5.49	0.99	1	0.318
Sibling x Distant x Voice Skype	-7.50	1.74	-10.90	-4.10	18.66	1	0.001
Sibling x Distant x Facebook	-9.45	1.86	-13.09	-5.81	25.88	1	0.001
Sibling x Distant x Letter	-5.31	2.57	-10.36	-0.27	4.26	1	0.039
Sibling x Distant x MMS	-17.94	1.45	-20.77	-15.10	153.81	1	0.001
Sibling x Distant x Face to Face	-0.34	1.91	-4.09	3.41	0.03	1	0.860
Sibling x Co-located x Face to Face	-0.38	1.36	-3.04	2.28	0.08	1	0.780
Parent x Distant x SMS	-10.30	2.25	-14.71	-5.90	21.04	1	0.000
Parent x Co-located x SMS	-10.52	3.54	-17.45	-3.59	8.85	1	0.003
Parent x Distant x Telephone	-5.19	1.75	-8.62	-1.77	8.82	1	0.003
Parent x Co-located x Telephone	-5.56	3.95	-13.30	2.19	1.98	1	0.160
Parent x Distant x IM	-0.84	1.64	-4.06	2.37	0.26	1	0.608
Parent x Co-located x IM	-18.85	3.04	-24.82	-12.89	38.36	1	0.001
Parent x Distant x Email	-8.57	1.94	-12.38	-4.76	19.42	1	0.001
Parent x Co-located x Email	-23.85	3.04	-29.82	-17.89	61.40	1	0.001
Parent x Distant x Video Skype	-5.25	2.18	-9.51	-0.98	5.80	1	0.016
Parent x Distant x Voice Skype	-5.90	1.79	-9.41	-2.38	10.81	1	0.001
Parent x Distant x Letter	-7.53	1.91	-11.27	-3.79	15.55	1	0.001
Parent x Distant x Card	-4.24	1.84	-7.85	-0.64	5.33	1	0.021
Parent x Distant x Face to Face	2.38	2.29	-2.10	6.86	1.09	1	0.297
Parent x Co-located x Face to Face	-11.80	2.57	-16.84	-6.75	21.00	1	0.001
Partner x Co-located x Face to Face	Comparison category						

Table 4.11: Parameter Estimates from the second repeated measures linear regression model

We are most interested in how communication technologies are used within partner relationships. Looking at this set of results, there are four main points worth making. The first is that in each case where we have data for both distant and co-located partners (SMS, Telephone, IM and Email), co-located partners are predicted to have lower SP scores than a distant couple using the same technology. For example, compare the use of SMS (see lines [1] and [2]) or IM (lines [3] and [4]) between co-located and distant partners. This reaffirms the point we made earlier; in distant relationships communication technologies are the primary means of communication. This is likely to increase the emotional meaning of these technologies compared to co-located relationships.

The second point follows on from this analysis. Distant partners communicating face to face are predicted to have higher SP scores than co-located partners communicating face-to-face. This argument is supported by the Mean and Standard Deviation scores for distant and co-located partners shown in Table 4.12. Seeing one another is more valued when people can't experience it regularly.

The third point is that our second model shows a similar split between technologies as seen in the first model. We can only compare Email, IM and SMS against Telephones as these are the only technologies which we have both co-located and distant partner data. As the divide remains the same, there remains the same difficulty in determining what the facets of the media are which cause this divide.

The fourth and final observation to make is that SP ratings of distant partners' use of Skype with video is not significantly different to co-located partners experience of face to face communication. This is of interest as it demonstrates that suitable communication technologies can be designed which can support high levels of Social Presence.

Our data shows that the choice of communication media is significant in helping to foster a sense of SP in LDDRs. This evidence suggests that the type of relationship has an influence on the value of a communication technology in supporting the relationship. Therefore relationship-specific designs are likely to be more successful than assuming that all communication technologies are equally appropriate for all types of relationships. This demonstrates that the design of communication technologies is a valid method of effecting change and supporting long distance dating relationships.

Having examined the relationship between communication technologies and a sense of Social Presence, we now move on to consider whether this feeling of Social Presence can predict feelings of Closeness.

Communication Media Media	**Total Number of Communication Acts for Distant Partners**	**Mean Contact SP Score *(SD)* for Distant Partners**	**Total Number of Communication Acts for Co-located Partners**	**Mean Contact SP Score *(SD)* for Co-located Partners**
Face to Face	43	61.67 *(2.72)*	79	51.29 *(8.32)*
SMS	52	46.75 *(8.76)*	55	41.85 *(7.65)*
Telephone	63	49.94 *(11.24)*	35	47.54 *(8.91)*
IM	2	47.00 *(1.41)*	8	38.50 *(10.52)*
Email	7	39.71 *(8.94)*	8	33.63 *(8.12)*
Skype (with video)	39	53.23 *(8.00)*	-	- *(-)*

Table 4.12: Mean and Standard Deviations of Contact Social Presence scores for each type of communication media for distant and co-located partners

4.2.3 Which factors can predict participants' Daily Closeness ratings?

RQ1.4 asks whether Social Presence ratings can predict ratings of Closeness. The question this Section seeks to address is whether SP (as realized during acts of communication and recorded in the Contact Diary) can predict the longer term feeling of Closeness (as measured through the Daily Diaries). We have already established that a repeated measures ordinal logistic regression is suitable to analyse which factors can predict participant's Daily Closeness ratings. This was calculated using the Generalised Estimating Equations facility in SPSS 20.

The first task is to establish which factors to use within the model. We have four main interests – whether relationship distance, relationship type, communication media and SP scores can predict levels of Closeness.

Our measure of SP can take 63 values; being an ordinal variable, this means we have 63 potential levels to predict against. This is too many to draw any meaningful data from the regression. Table B.3 in Appendix B.4 shows the results of the regression model for all 63 levels; although the model does not converge (the Hessian matrix for the model is singular), casting doubt on the validity of the model, the pattern remains consistent with the tests we are about to report.

In the first regression model, the SP ratings are grouped into one of three levels: low = < 30, mid = 31 – 49 and high = 50 – 63.

There are a number of possible ways of combining our parameters to predict levels of Closeness. Table B.2 in Appendix B.4 details the convergence of a number of combinations of factors which could be analysed by the regression test. The lack of convergence of any model containing communication media as a parameter suggests that communication media are not strong predictors of Closeness ratings. This could be interpreted as evidence that Closeness operates over a longer period of time than single acts of communication, as we argued earlier.

We selected Social Presence with relationship type x relationship distance as the model underlying our regression test. This model fits the criteria of being statistically significant, a model which converges and which is meaningful to interpret.

The regression model indicates that both relationship x distance (wald chi-square(7) = 15.718, $p = 0.001$) and SP level (wald chi-square(2) = 28.256, $p < 0.001$) are significant predictors of Daily Closeness ratings. Table 4.14 shows the details of the regression model.

The grouping of the SP ratings into three levels assumes that the threshold values of 30 and 50 correspond to ratings that are below or above points of neutrality. To demonstrate the robustness of our analysis, we re-grouped the SP ratings into one of three levels with different thresholds: low = < 40, mid = 41 – 54 and high = 55 – 63. The regression model also indicates that both relationship x distance (wald chi-square(7) = 88.528, $p < 0.001$) and SP level (wald chi-square(2) = 38.012, $p < 0.001$) are significant predictors of Daily Closeness ratings. As Table 4.15 shows, the details of the model are effectively indistinguishable from the previous model in terms of the significance of parameters contributing to the model.

Five factors were significant predictors of Daily Closeness scores, three relationship type x relationship distance and both SP groupings.

Taking the Social Presence data first; both mid and low SP scores predict a lower level of Closeness than high SP scores. Additionally, low SP scores predict a lower Closeness score than mid SP scores. This corresponds to the relationship between SP and Closeness which

we proposed earlier. Our data supports our argument that each act of communication has an impact, to the extent that it generates a sense of SP, on the longer-term feeling of Closeness.

It is worth reiterating why this is of importance. The relationship between SP and Closeness indicates that through creating technologies which help to create emotionally significant experiences during acts of communication, designers have the potential to help support personal relationships in a more meaningful, long-term fashion. Furthermore, creating new technologies is easier than changing social structures of impacting relationships in other ways. If technologies can be associated with high or low levels of SP, then we can make plausible claims about the technology's impact on the relationship's feelings of Closeness, and subsequently the state of the relationship more generally. As SP has a positive association with Closeness, we have further validation for our selection of SP as the concept to support in long-distance relationships.

Turning our attention to the relational qualities; distant friends, co-located siblings and co-located parents were all significantly different to the comparison group of co-located partners. Co-located parents and distant friends both predict a lower Closeness level than co-located partners whereas co-located siblings predict a *higher* level of Closeness than co-located partners. These results are difficult to interpret; they do not correspond that well to existing theory of the determination of Closeness by relationship type (e.g. [Dunbar, 2010], full discussion in Chapter 2). Although the data displays a difference for some interactions between relationship type and distance, the pattern is not consistent, nor do those significant interactions follow a clear pattern. We would anticipate that co-located partners would have the highest ratings of Closeness, hence selecting it as the comparison category. It is then unsurprising that other relationships, namely distant friends and co-located parents, predict significantly lower Closeness ratings. It is harder to explain the significantly higher prediction of Closeness by co-located siblings. The most straightforward interpretation is simply that the single participant reporting on their co-located sibling felt Closer than the co-located partners who participated in this study.

An alternative interpretation is based off the fact that each participant only reported on a single relationship. Therefore we do not know the relationship status of our participants regarding the relationship types that each participant was not reporting on. It is possible that those participants reporting on their co-located siblings did not, or had never had, an intimate partner. In those circumstances, their sibling would remain in their 'inner circle' of Close relationships, must likely consisting of their nuclear family. Such an interpretation is impossible to investigate with the data set we have. This could be compounded by self-selection bias; people who have chosen to report on their communication habits with the sibling when asked to report on 'a person you feel close to' may have an unusually close relationship with their sibling.

A final interpretation is based around certain characteristics of our selected population of students. Unlike those in later life, most students' intimate relationships have not existed for very long – as Table 4.13 shows, on average our participants' partner relationships had only existed for around 3.5 years. In comparison, sibling relationships have existed for the majority of our participant's lives, on average around 22 years. Distinct from parental relationships, siblings grow up together, share experiences and progress through life at the same rate, experiencing similar changes and rites of passages. This could create an intense sibling bond which is stronger than a weaker partner relationship where the partners have not grown together. This balance is likely to shift depending on the age of participants – couples who have been together for 20 years have gone through a similar process of experiencing life together and one would expect

that bond to be stronger than couples who have dated for a few years.

Relationship Type	**Mean time of Relationship Length (years) *(SD)***
Partner	3.57 *(1.83)*
Friend	5.63 *(4.83)*
Sibling	21.82 *(3.03)*
Parent	22.98 *(2.91)*

Table 4.13: Mean length of relationship of participants by relationship type

Unlike Social Presence levels and the relational qualities, communication medium does not predict Closeness ratings. Communication media only appear to have a relational impact via the experience of Social Presence (which is additionally contributed to by relationship distance and relationship type). This supports the argument we made earlier regarding Closeness being a longer-term concept than Social Presence. If individual acts of communication (which occur in the short term) have no impact on feelings of Closeness, it logically follows that the choice of communication media would have no impact on feelings of Closeness.

			95% Wald Confidence Interval		Hypothesis Test				95% Wald Confidence Interval Exp(B)	
Parameter	**B**	**Std. Error**	**Lower**	**Upper**	**Wald Chi-Square**	**df**	**sig**	**Exp(b)**	**Lower**	**Upper**
Friend x Distant	-1.22	0.49	-2.17	-0.26	6.18	1	0.013	0.296	0.11	0.77
Friend x Co-located	-0.49	0.52	-1.50	0.52	0.89	1	0.344	0.613	0.22	1.69
Sibling x Distant	-0.98	0.56	-2.08	0.12	3.07	1	0.080	0.374	0.13	1.12
Sibling x Co-located	0.65	0.31	0.03	1.27	4.28	1	0.039	1.915	1.03	3.55
Parent x Distant	0.23	0.46	-0.67	1.14	0.26	1	0.610	1.263	0.51	3.11
Parent x Co-located	-1.27	0.59	-2.42	-0.12	4.72	1	0.030	0.280	0.09	0.88
Partner x Distant	0.12	0.54	-0.94	1.18	0.05	1	0.829	1.122	0.39	3.23
Partner x Co-Located	Comparison category									
Low SP Score	-1.21	0.40	-1.99	-0.43	9.24	1	0.002	0.299	0.14	0.65
Mid SP Score	-0.91	0.17	-1.25	-0.57	28.15	1	0.001	0.403	0.29	0.56
High SP Score	Comparison category									

Table 4.14: Parameter Estimates from the repeated measures ordinal logistic regression

			95% Wald Confidence Interval		Hypothesis Test				95% Wald Confidence Interval Exp(B)	
Parameter	**B**	**Std. Error**	**Lower**	**Upper**	**Wald Chi-Square**	**df**	**sig**	**Exp(b)**	**Lower**	**Upper**
Friend x Distant	-1.04	0.39	-1.81	-0.28	7.10	1	0.008	0.353	0.16	0.76
Friend x Co-located	-0.41	0.40	-1.19	0.37	1.08	1	0.299	0.661	0.30	1.44
Sibling x Distant	-0.79	0.51	-1.79	0.21	2.43	1	0.119	0.452	0.17	1.23
Sibling x Co-located	0.98	0.27	0.45	1.51	13.24	1	0.001	2.664	1.57	4.52
Parent x Distant	0.45	0.43	-0.39	1.29	1.12	1	0.291	1.573	0.68	3.65
Parent x Co-located	-1.10	0.56	-2.19	-0.01	3.89	1	0.049	0.333	0.11	0.99
Partner x Distant	-0.01	0.46	-0.91	0.91	0.00	1	0.995	0.996	0.40	2.47
Partner x Co-Located	Comparison category									
Low SP Score	-1.34	0.22	-1.78	-0.90	35.67	1	0.001	0.261	0.17	0.41
Mid SP Score	-0.99	0.19	-1.37	-0.63	28.06	1	0.001	0.369	0.26	0.53
High SP Score	Comparison category									

Table 4.15: Parameter Estimates from the repeated measures ordinal logistic regression

4.3 Qualitative Results

Our quantitative data were gathered in order to both help clarify the relationship between Social Presence and Closeness and to investigate how various factors impacted upon ratings of Social Presence. Our interest in Social Presence is more holistic than this; we want to determine which factors of communication technologies influence both why people use particular technologies and how those technologies impact their feelings of Social Presence.

The research packs we issued to each participant included a set of general medium-based questions to prompt free-text responses about the various communication media they used within their relationship. Participants were asked to complete these questions after the 21-day study period was complete. The questions were intended to expose a general attitude in the relational context accompanied by relevant accounts of their own experience:

- Why do you like using [medium] to communicate with [the other person]?
- Why do you not like using it?
- Can you give an example when you wanted to communicate with [the other person] using [medium]?
- Can you give an example when you didn't want to communicate with [the other person] using [medium]?
- Can you give an example when you used [medium] to communicate with [the other person] and in hindsight would have preferred to communicate using a different medium
- Can you give an example when you didn't use [medium] to communicate with [the other person] and in hindsight would have liked to have done so?

In total, 44 participants returned responses to these free-text questions. Table 4.16 shows how these responses were divided between the various relationship types involved in this study. In general, participants answered each question with between one and five sentences. Each participant completed a set of responses dependent on the set of technologies that they had used during the study.

Relationship Type	**Number of Participants**	**Number of Qualitative Responses**
Partner	16	9
Friend	16	12
Sibling	11	10
Parent	20	13

Table 4.16: Number of qualitative responses by participant's relationship type

The free-text responses returned by the participants in our study help to bridge the gap between understanding media differences via relatively abstract experiential ratings and everyday concerns. Categorical contrasts, such as IM versus SMS, can be reconsidered to try to show how facets of media might impact upon the experience of SP by interacting with our participants'

construction of their relational meaning. The responses were analysed using the thematic analysis technique we discussed in Section 3.3.1. We resolved on six themes that encapsulate the perspectives expressed by our participants, *time and effort, manageability, personal connection, physicality, fleetingness, responsiveness.* Table B.4 in Appendix B shows how the themes were developed. There were between 1 and 4 codes which were combined to form these themes. In the following discussion, participants are identified by anonymized prefixes along with the relationship they are talking about (e.g. A23 [partner]:) as is the communication setting (e.g. [SMS]). We present the factors we derived along with some illustrative quotes.

We do not discuss the relation these themes may have to other literature at this stage of the thesis. The themes form a foundation for our understanding of those qualities which are important in the design of communication technologies for long distance dating relationships. In the next Chapter we analyse previous attempts to design relationally meaningful communication media. In Section 5.4 we combine this analysis with the themes discussed here, alongside our design insights, to present a provisional set of device criteria for LDDR communication media.

Thus far in the thesis we have used the term 'design facet' extensively without discussing what we mean by this term. It is important to clarify the term at this point as the themes we are about to present could be considered to be be design facets themselves. These themes are refined over the course of this thesis to produce a series of well thought through facets, with a substantial amount of evidence, which combine to make up our design space, as presented in Section 6.4.

A design facet simply refers to a specific property of a given design which can take multiple values. A designer has to select an appropriate value for that property (from the various values the property can take) given all the other information the designer has. Theoretically there are a near infinite number of properties that a given design can have. Part of the designers job is to select those properties which are meaningful and then make decisions about the values those properties should take. For example, when considering a chair, it is more important to consider the property of 'back support' than 'wifi connectivity'. Having decided that 'back support' is a suitable property, the designer then has to consider how that property should be realised within their design.

The reason for using the term 'design facet' is that it emphasises the fact the each property speaks to a small element of the overall design and that different facets can interact with one another and change the meaningful values which can be ascribed to one another. To continue the chair example, 'back support' is a minor element in the consideration of designing a chair but having selected that it is necessary, the choices available in, for example, the types of materials to build the chair out of or whether the chair has a back or not are reduced.

When combined, a series of related design facets can be considered as a design space, a conceptual space in which decisions about multiple properties can be taken in such a way that the interactions between the individual facets is clearer. We discuss the concept of a design space further in Section 5.4.

4.3.1 Time and effort

One of the most common themes in participants reports simply concerned the amount of work involved in responding to messages in their close personal relationships. Although perhaps

mundane, it is important to understand that in their daily lives, communications activity has to be juggled around other activities and convenience is important in this respect. 36 of our 44 participants discussed time and effort in some form within the questions, with 8 of our 9 responding partners discussing the theme.

> A43 [Parent]: "Sometimes when it's boring things I get too lazy to reply to emails"
> A42 [Parent]: "[letters] time consuming, slow, not easy to respond to"

The telephone, face to face and text messaging were repeatedly described as being less effortful. Comments about SMS messages were often interwoven with a concern for the interests of the other person:

> A55 [Parent]: "[telephone] easiest to communicate longer messages by"
> A42 [Parent]: "[IM] Can do other tasks at the same time"
> A48 [Sibling]: "[SMS] Quick and easy to send a text [and] If not convenient then can reply later"
> A50 [Sibling]: "[SMS] Convenient. He will get my communication quickly and reliably"
> A51 [Parent]: "[SMS] When I met my brother for the evening, I was late getting back so I text my Mum to let her know I was back fine"

Contrasting the low SP rankings predicted by SMS messages (see Section 4.2.2) it becomes clear that technologies are not always selected on the basis of which will deliver the most emotional experience. Other concerns, some beneficial to the sender of messages, others beneficial to the receiver help determine which media to communicate through. In this case, the asynchrony of SMS appears to be convenient for users at the cost of creating an emotionally weaker connection.

4.3.2 Manageability

'Manageability' is intended to reflect our participants' concerns about how fit for purpose particular communication media are within their relationships. That is, their comments reflected the degree of deliberation that contributes to the desirability of talking to a loved one through technology. 23 of our 44 participants discussed how they managed their communication, with 8 of our 9 responding partners discussing the theme.

There is a close relationship between effort and manageability since the value of the media determines how worthwhile it is to invest time and effort in using that particular technology.

> A45 [Friend]: "[SMS] Appropriate to arrange a meeting, to share an experience he would like, to ask a short question but not appropriate to express complex ideas/discuss sensitive topics."
> A62 [Friend]: "[Phone contrasted with IM] When upset about something, sometimes MSN doesn't cut it."
> A98 [Friend]: "[SMS undesirable] when we were discussing something of personal importance."

4.3.3 Personal connection

Beyond issues of effort and manageability, our participants repeatedly made reference to the importance of a sense of personal connection to those they care about. 38 of our 44 participants discussed how their communication habits helped form a personal connection with the person they were communicating with. 8 of our 9 responding partners discussed forming a personal communication with their partner.

Comments reflected the difference we found in Section 4.2.2 with regards to those communication technologies associated with differing degrees of emotional connectedness. Those media based around around voice-messages were associated with creating a more personal connection in addition to predicting high levels of Social Presence (see Section 4.2.2).

> A51 [Parent]: "[face-to-face] Sometimes if I phone her it's not the same as talking in person. I feel closer to my Mum if I meet her."

A51 was talking in real-time to their Mother, but did not feel as emotionally connected as they wanted to. Statements also combined a differentiated viewpoint on the nature the connection made possible by technologies and the desirability of a routine kind of intimacy.

> A43 [Parent]: "[Phone vs. SMS and Email] Sometimes I wish I talked on the phone more for mundane everyday things (that we usually text about) not just at the extremities of emotion. I think it would make me feel closer to her because it would be like chatting at home ... it is a nice intimate, expressive communication method compared to texting or e-mail."

This corresponds with Duck's view of relationships being primarily grounded in 'everyday talk' [Duck and Pittman, 1994]. However, it should not be forgotten that relationships are punctuated by life events and emotional extremes that can make the perceived shortcomings of available technologies all the more difficult to bear:

> A71 [Friend]: "[face to face] [I wanted to talk to him] when he was upset because he was missing his dad who died a year ago."
> A90 [Sibling]: "[Skype+video] makes me miss them more."

The personal connection supported by certain technologies generally stemmed from the ability to accurately exchange emotions through the medium rather than other personal cues such as in-jokes or other personal idioms.

> A1 [Partner]: "[face to face] Get a sense of emotion and feeling through body language and facial expressions"
> A42 [Parent]: "[Phone] When I was missing them, to hear their voice over the phone would have been great"

It is notable that comments on media which were more personal (e.g. phone, face to face) bear unique traces of individuality (e.g. voice, seeing the person) whereas communication

technologies without such traces lacked reference to such matters. For example text messages always look the same regardless of who they're from. The 'personal' technologies also emphasize real-time exchanges with a variety of expressive opportunities. It may be the case that in certain cases, communication can be personal but afterwards could cause more loneliness as the difference between mediated communication and physical presence is put into sharp relief.

4.3.4 Physicality

Emotion, closeness and intimacy were frequently described alongside tangible experiences with loved ones, as examples of real or preferred face-to-face encounters were described. 5 of our 44 participants discussed how physicality was important to their communication habits. 3 of our 9 responding partners discussed the importance of physicality. Hugs and cuddles were repeatedly discussed in our participants' reports:

> A48 [Sibling]: "[face to face] I think there is a stronger bond if you can have physical contact. Having a big bear hug from my brother means a lot."
> A82 [Partner]: "[face to face] It is more physical... can actually see him in person. Actually being in the same place is nice."
> A87 [Partner]: "[face to face] When I've got lots of work and need a cuddle."
> A69 [Parent]: [face to face vs. telephone] "Anytime I've felt low and just wanted a hug."

The theme is carried across other media. A85 [Friend] described the problems with the phone as:

> "When one party is upset it's hard to comfort with words alone"

This helps us to understand why the qualitative data shows face-to-face episodes predict the highest Social Presence scores. Not only does face-to-face communication encourage rich meaningful acts of communication alongside everyday talk, physical presence means that emotionally significant acts (such as a hug or a reassuring pat on the back) can be exchanged.

4.3.5 Fleetingness

Communication occurs in the moment but resides in the minds of people in relationships afterwards. Comments demonstrated sensitivity to the ephemerality of talk, reflecting the difference between something fleeting, such as a phone call, or realised in persistent form, such as an email, letter or text message. Episodes that are not fleeting can be revisited, and re-experienced, after the fact. Only 3 of our 44 participants discussed the fleetingness of their communication. None of these participants was reporting on their partner relationship. This could indicate that this is a theme which, while possibly important, is not a high priority for most people.

> A60 [Parent]: [SMS] "I can go back to it."
> A45 [Friend]: [Email] "It can be saved for later."

SMS and Email permit recapturing of the moment. Our ratings data suggest they are associated with weaker feelings of SP (see Section 4.2.2) but, perhaps because they present opportunities to reread words sent to them, they involve an emotional connection which exists beyond the act of sending or receiving the message. Such a connection would be unlikely to show up in the ratings data given the primacy of the communicative act in the Semantics Differentials measure. To some extent, absence is mitigated by evidence that the separated other has held the recipient in mind, and the recipient reflexively holds the other in mind when revisiting their messages.

4.3.6 Responsiveness

15 of our 44 participants distinguished between those media that are likely to engender a delayed response and have an uncertain time of receipt. These are familiar ideas in a business setting but perhaps the sense of them differs in an important way when considering close personal relationships. 2 of our 9 responding partners discussed this theme.

> A50 [Sibling]: "[Email] [dislike because] delayed response[s]."
> A84 [Partner]: "[Email] can take forever to reply."
> A92 [Parent]: "[SMS] You don't know whether they have received the message."

Equally, comments also reflected an understanding of the everyday constraints on the absent other relating back to time and effort as important concerns:

> A97 [Parent]: "[Phone] Small success rate (often no answer)."

Certain media, particularly asynchronous ones, were negatively associated with delayed messages. This indicates that a synchronous connection, although harder to manage, is preferred within personal relationships for it's ability to foster a connection between the couple. Such a connection is difficult to establish using asynchronous technologies.

4.4 Discussion

Not all of the factors we have discussed here are derived exclusively from statements made by long distance couples. This is by design; this study was intended to explore what Social Presence meant across a number of relationship types and distances. A result of this is that the data from LDDR couples is smaller than if we had recruited 64 people in that relational situation (losing our ability to explore the impact of relationship types and distances on ratings of SP). Therefore, a lot of the data we have to analyse is from relationships which are not in our target demographic.

We do not consider this to be a flaw. Instead, we would argue that this strengthens our analysis; gathering data from a larger set of people allows us to explore ideas which LDDR couples may not have thought of and yet have an impact upon them. Of course an alternative interpretation is that these themes are irrelevant to LDDRs. In the next Chapter we demonstrate how these

themes are supported by other literature; this indicates that these themes are meaningful in the context of LDDRs.

Our study is limited in that data collected with longitudinal self-report studies represent a particular perspective on every-day phenomena. People may self censor, confabulate and forget to report or miss relevant episodes. The risk of these was minimised by making the diary entry requirements as short as possible such that the effort required to fill them in was minimised. Beyond that, the limitations of the methodology must be acknowledged. These limitations remain relatively minor compared to other methodological approaches.

We have attempted to maintain a rigorous approach in collecting and analysing our data. Two participants' diaries were rejected as the SP measure was consistently rated at its maximum for all acts of communication and the Closeness measure was consistently rated at its maximum every day. Both participants were reporting on their long-distance romantic relationships. This was deemed as being indicative of a lack of reflection and as such likely to negatively impact the validity of any statistical test which used this data. There is a risk of over estimating SP and Closeness scores in romantic category as participants are pre-disposed to score these measures highly. Beyond the removing of obvious cases from the data set, there is little we can do to overcome this, limiting the conclusions we can draw from the data.

4.5 Summary

This Chapter aimed to analyse some of the important factors of Social Presence when considering how to help support long-distance romantic couples. Our exploratory study has addressed our 4 research questions, to whit:

- **RQ1.1: Do Romantic relationships differ from other relationship types in terms of SP ratings?**
- **RQ1.2: Does the Distance-status of a relationship impact ratings of SP?**
- **RQ1.3: Does the type of Communication Media have an impact on ratings of SP?**
- **RQ1.4: Do SP ratings predict feelings of Closeness?**

To summarise our findings, this study has found:

- Empirically we have collected a new set of data to investigate the factors which have an impact on ratings of SP in addition to establishing an association between Social Presence and Closeness.
- Our data indicate that SP and Closeness are suitable constructs to support within long-distance relationships. The high SP ratings for distance partners indicate it's significance to this relationship type.
- Relationship type and relationship distance predicts feelings of SP experienced through a single act of communication

- Communication media predicts feelings of SP experienced through a single act of communication. This demonstrates that the design of communication technologies is a valid method of affecting change and supporting long distance dating relationships.
- Relationship type and relationship distance predicts feelings of Closeness experienced daily by an individual
- SP ratings from individual acts of communication predict feelings of Closeness experienced daily by an individual
- A number of factors, specifically time and effort, manageability, personal connection, physicality, fleetingness and responsiveness, were identified as important in people's selection of communication media within their personal relationships
- Methodologically we have extended previous work by combining both quantitative measures alongside a qualitative investigation of Social Presence

These results all to our overall research question of:

> **RQ1: How should we think about Social Presence with regards to close personal relationships?**

The work in this Chapter is based on answering the questions raised by our literature review of Social Presence and LDDRs presented in Chapter 2. By considering the impact relationship distance, relationship type and communication media have on ratings of Social Presence we validate the choice of Social Presence as being a significant concept in the context of LDDRs and something which we can change through the design of communication technologies. This makes SP a meaningful concept to use throughout the rest of this thesis. We have also demonstrated the wider relational significance of Social Presence through it being able to predict ratings of Closeness. Both mid and low SP scores predict a lower level of Closeness than high SP scores. Additionally, low SP scores predict a lower Closeness score than mid SP scores. This relationship suggests a model of emotional connectedness that incorporates feelings of Social Presence and Closeness. Our data supports our argument that each act of communication has an impact, to the extent that it generates a sense of SP, on the longer-term feeling of Closeness.

The design facets we discussed at the end of this Chapter form the bedrock of our consideration of the concepts which we suggest are significant to bear in mind when considering the design and creation of a new communication system for long-distance partners as discussed in Section 5.4.

In the next Chapter we move on from considerations of Social Presence and Closeness to describe the development of the behaviour-based communication technologies used within this thesis. These devices are heavily influenced by our analysis of existing devices for LDDRs in addition to being guided by the design factors established within this Chapter.

Chapter 5

Device Development and Initial Design Space

In the previous Chapter we discussed a number of novel devices developed for the purpose of trying to support long distance relationships. We concluded that touch and tangible media are special within intimate relationships, and that the ability to invest meaningful effort into the act of communication was valued. We also discussed how using elements of personalisation, attributes of personal uniqueness, could be a powerful way of reinforcing relational bonds. We finally observed that few designers have considered how to mimic co-located behaviours to establish a behavioural metaphor which can be used to underpin the design of communication systems. All of these design facets are conditioned by the capacity of partners to attribute significance to them in the context of their relationship.

In this Chapter, we extend the field by developing seven new devices, using different co-located behaviours as design inspiration, utilising the four facets of design we identified as being significant, namely personalisation, effort, metaphor and sensory medium as design inspiration. These devices were created to assist us in answering our third research question:

> **RQ3: Do novel designs for devices based on the design facets from RQ2 engender positive feelings of emotional connectedness?**

After presenting the devices, we discuss an initial proposed design space which consists of six parameters which devices can or cannot contain. We make no strong claims about the necessity of these design facets but argue that they serve to map out part of the conceptual space which communication technologies for LDDRs exist within. This design space helps us to address our second research question:

> **RQ2: What design facets are significant when considering the design of communication technologies for long distance dating relationships?**

An initial evaluation of the design of these devices in reported in Chapter 6.

5.1 Design Process

Although this thesis is interested in the design of communication technologies, we are not focussed on the process through which designs are created. However, in this Section we outline how our process of design relates to broader debates within the design community.

Dorst and Dijkhuis [1995] has argued that there are two broad ways of describing the process of design: design as a rational problem solving process or design as a process of reflection-in-action.

Simon [1996] was the main proponent of design as a rational process (also known as being reason-centric). This process characterises design as a search process, in which designs are selected based on how well they fulfil the needs of a set of fixed requirements and constraints.

Some researchers have argued that the reason-centric process is not an accurate reflection as to how designers actually work. Additionally, the process assumes that requirements and constraints are well-known and fixed [Ralph, 2010].

Schon [1983] saw design as a 'reflective conversation with the situation'. Problems are framed by designers (where goals are identified), who then take actions (or make 'moves') which are then reflected upon as to whether the new design has improved.

It has been argued that reflection-in-action is better suited for conceptual problems with no clear strategy to success [Dorst and Dijkhuis, 1995]. In our case, we have followed a reflection-in-action process, given it's ability to explore ill-defined design problems and it's focus on the experience of the designer. Research and knowledge are brought into the design process through the judgement of the designer; in this thesis, this knowledge has focussed around the metaphor behind the device and the facets of design discussed in Section 2.10. We discuss the selection of this design process, of using reflection-in-action, in the conclusion of this thesis in Chapter 11, reflecting on how it shaped the design of our devices.

After the development of a number of prototypes, which have been refined through periods of reflection, we now present seven devices, based on the mimicry of co-located behaviours, intended to support Long Distance Dating Relationships.

5.2 The Devices

Our devices were built for four main reasons. The first is that there is little in the literature about communication devices being based on co-located behaviours and we wanted to explore whether such devices could help support LDDRs. In order to evaluate such devices, it was felt that having example devices would help people to understand the idea. Related to this is the second reason for developing them – in order to be able to investigate how such devices could fit into people's communication patterns and whether such a device had an impact on their relationship, we needed working devices (see Chapters 7 through 10).

The other two reasons are based around the desire to explore the parameters of designing communication devices for LDDRs. We want to develop an understanding of the design space which surrounds the development of communication devices to support long distance relationships. The development of the devices gave us the ability to reflect upon design facets through the creation of such communication systems. They additionally gave us the ability to let us explore

what people think about the design facets, as embodied in the devices (see Chapter 6). We should note that we are not adopting a participatory design approach (as advocated by Schuler and Namioka [1993]) as we are interested in exploring the potential space for design, rather than creating an ideal device for a specific group of users.

In order to present our analysis of people's perception of the design facets and the impact on relationships, we first need to discuss the devices and what design facets were embodied in their creation. We will not describe the technical details of how the systems are developed except where these details assist in describing the design facets. This is such that the design ideas are more clearly expressed without the non-pertinent technical information. The following Sections describe the seven devices, how they work and what design facets were emphasised during their creation. In each case, descriptions adhere to a common format. First we present a description of the device and how it embodies a particular behavioural metaphor. Secondly we discuss how the devices embodies the remaining three design facets we've previously identified as being meaningful, namely personalisation, effort and sensory medium. Finally we identify other design facets which were revealed through the process of designing the communication system, discussing the concepts of fleetingness, openness, serendipity and availability. Relevant work from the HCI literature is discussed throughout these descriptions to compare and contrast our devices with similar work.

5.2.1 Magic Sock Drawer

The first device to discuss is the Magic Sock Drawer (MSD). This device took it's design inspiration from the practice of private note-sharing, a behaviour common to many intimate couples. Love notes are a co-located form of love letter where the author constructs a relationally meaningful note, typically utilising emotions and/or personal idioms. The note can then be hidden to create a pleasant surprise for the author's partner when the note is discovered. The MSD tries to recreate a similar form of communication for distant couples. The MSD consists of two devices where each device is made up of a tablet PC and a mini printer (see Figures 5.1 and 5.2). Installed on each PC is some custom software which allows participants to create either free hand (Figure 5.3), typed (Figure 5.4) or combined (Figure 5.5) notes. The free-form interface allows notes to be created using the tablet-pen meaning that people can write and draw whatever they like on the note. The typed interface allows people to type out text which is then placed onto the note. The combined interface allows people to create notes using both text and free-form drawing. When these notes are sent, they are saved as images, sent to the other tablet where they are automatically printed out on credit-card sized glossy paper. These printed notes are also stickers.

There were 4 main design considerations during the development of the MSD, making it distinct from other work in the literature.

The first primary concern during the the creation of the MSD was how changing the level of personalisation of the notes affects how people feel about the system and the notes they receive. As we discussed in the previous Chapter, digital communication systems often remove much of the personalisation that is present in older communication forms. It is important at this stage to reiterate what we mean by personalisation or rather, what we don't mean. We are not talking about facilities such as changing the typeface or colour of text within the communication media, nor the content being tailored towards an individual. What we mean by

Figure 5.1: The Magic Sock Drawer

Figure 5.2: The printer element of the MSD

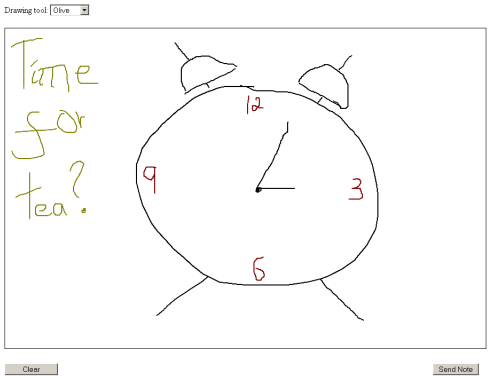


Figure 5.3: The Free-Form Interface

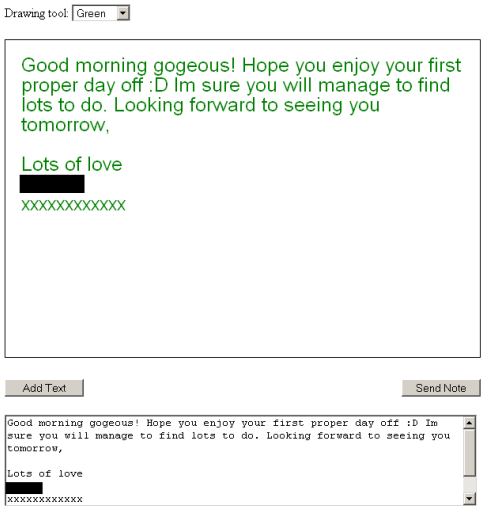


Figure 5.4: The Typed Interface

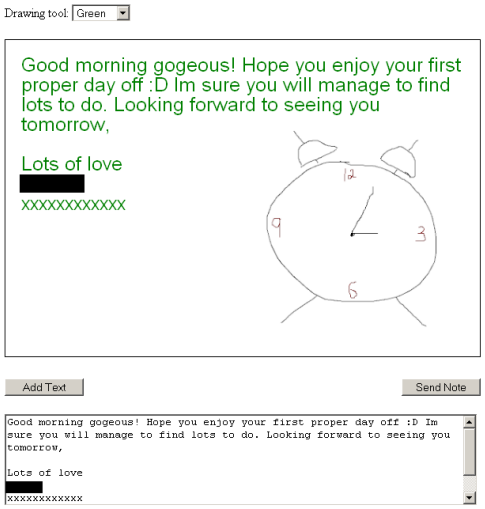


Figure 5.5: The Combined Interface

personalisation is communication which has a touch of the other person imbued within it. For example, a hand-written letter has a person's hand-writing in it, something directly traceable to that individual. Similarly, talking to someone involves the use of people's voices.

The way of realising different types of personalisation was through the different interfaces (free-form, typed and combined). These interfaces gave us the ability to explore how different types of personalisation (or lack thereof) affected how people thought about notes that they received (see Chapter 7).

Although not a primary consideration in of itself, related to personalisation was another design facet we were interested in; namely effort. The way that our interfaces realise the ability to personalise the notes has a trade-off against effort. It is much easier to type out a quick message then it is to craft a beautiful note using the free-form interface. Although the interfaces do not have to be used in that way, they predispose that kind of use. We think that it is more effortful to create a note using the free-form interface then it is to create one using the typed interface. This is because we believe that the free-form interface encourages users to invest substantial amounts of time in constructing pictorial notes; time which we would not expect authors to invest in reflecting upon the words they have typed. As we discussed in Section 2.10, Riche et al. report that when discussing digital versus traditional communication participants preferred traditional methods as digital messages are "easier to create and less sensual. Participants explained finding a special value in the effort others made to create and send messages" [Riche et al., 2010]. Effort is not always a bad thing and we wanted to explore whether the different interfaces (and different types of personalisation) encouraged people to expend more or less effort and whether such effort was appreciated by the receiver of the note.

The MSD is not the first system to look at sharing notes with loved ones or with situated messaging. As our analysis in Chapter 2 highlighted, the majority of 'behaviour-based' systems have focussed on sharing notes. Both Microsoft's HomeNote system ([Lindley et al., 2009b], [Sellen et al., 2006b]) and, to a lesser extent, HERMES and SPAM ([Cheverst et al., 2007]) present similar ideas. One of the big differentiations from these systems is the tangible aspect of the MSD. Both HomeNote and HERMES focus on using a digital display as the form through which messages are received. Our messages are received in a physical form, namely on paper.

Tangible notes offer two advantages over non-tangible notes – they can be displayed and they can be treasured and carried around more easily. Our analysis of Social Presence (see Chapter 4) and Closeness (see Section 2.5) suggests that physicality has a significant role to play in people's communication habits. By creating tangible notes, we wanted to explore whether the MSD helped to fulfil that role. Although the message itself is not tangible, being based on the visual nature of the note, the printing aspect of the MSD ensures that the message is viewed on a piece of physical material. This form of indirect touch is quite distinct from the way touch is usually used as an interaction technique (see Section 2.11.2).

As an interesting aside, it is worth discussing the peek-a-drawer system, [Siio et al., 2002]. The communication system consists of two bedside cabinets. Placing an object into one of the drawers causes a photo to be taken of it. This image is subsequently displayed on a LCD screen in the other drawer in the other cabinet. The peek-a-drawer imbues many of the design facets which have fed into the development of the MSD. Interestingly, the peek-a-drawer takes a physical artefact and turns it into a digital representation which was presented at the remote location whereas the MSD system takes a digital representation which is then turned into a physical artefact and produced at the remote location.

The third primary design facet is that of the openness of the communication system. This design facet was identified by reflecting upon the possible ways in which a sender can be connected to a receiver. Many of the communication systems we use on a daily basis use a many-to-many design. This means that many people can contact you (and you can contact many people) using the same device. For example, anyone can email your email address (assuming they know what it is) and you can email anyone from the same address. This is what we mean by 'openness' – who can communicate using the device. Communication systems need not be many-to-many. Many-to-one systems do exist, the clearest example of which is an intercom system. Likewise, the best example of a one-to-many systems is a broadcast network, something which is not really relevant to communication amongst intimate couples. The final type is one-to-one whereby you can only contact one person through the system and conversely, that person can only contact you. In the context of LDDRs, we wanted to explore whether knowing that a message must be a token from your partner made the MSD notes more relationally meaningful.

With regards to research-based communication systems it is worth making a distinction. Some research systems are clearly intended to be expanded to many-to-many systems but appear to be one-to-one as only two devices have been made (e.g. the Gumball machine by Truong et al. [2004]); others are intended to be 1-to-1 by design (e.g. the VIO by Kaye [2006]).

It is made clear to participants that only their partner can contact them using the MSD. This means that when they see a note, they instantly know that it has been sent by their partner and that it is exclusively for them. The reason for doing this is to identify the experience of interacting with the other person with the use of the system. When you use the same phone to speak to your bank manager and your lover, there is no way of attaching significance to the phone as a means of intimate communication. We hope to challenge that assumption with the MSD. There is some social behaviour to support this - keeping a personal and business phone for example - but the focus is making this knowledge clear to the MSD users.

Sellen et al. [2006b] demonstrated that there is value in exchanging personalised notes in the home environment. These were shown to be used to request action, express affection and marking identity in a household, the expression of affection being of particular concern to us. Most interestingly, it was argued that "HomeNote would be better if it allowed people to respond to messages, and in particular to easily identify who was responding to any given message" [Sellen et al., 2006b, p. 391]. HomeNote was deployed in a family environment where there are multiple people who could respond – the quote illustrates a desire for comprehension of who was the 'sender' of any particular message. However, it could indicate something more fundamental about the values that people ascribe to messages based upon the sender of the note – this is what the closed nature of the MSD is intended to investigate.

The final design facet within the MSD is that of serendipity. Work in other contexts has shown the delight that people have for receiving things through snail-mail ([Kelly and Gooch, 2012, Davis et al., 2008]). One of the factors which was identified as being significant for creating this delight was serendipity – the pleasant discovery of a message without necessarily expecting such a message. Related to serendipity is the concerns of time and effort we found during our analysis of Social Presence (see Chapter 4). Serendipity can also be considered in terms of gift-giving, where the receiver was not anticipating being given a gift. Given our previous discussion regarding the relational meaning behind gift-giving (see Section 2.7.3), and the association between serendipity and gift-giving, we might anticipate that serendipitous communication could be used to support LDDRs.

Serendipity is built into the MSD through the use of a mini-printer. Due to it's size, and the fact that it is connected to the tablet PC wirelessly using bluetooth, means that the printer can be hidden in an intimate location (hence the 'Sock Drawer' part of the name). There are two reasons for 'hiding' the printer. The first is that notes are found at random times of the day. We were trying to prevent participants from looking for the notes in order to increase the serendipitous nature of the system. The second was that by asking participants to place the MSD in a intimate location we were hoping that people might associate the notes with this location and thus have an impact on how the notes and system are regarded by it's users.

5.2.2 DoodleMessenger

DoodleMessenger is a further development of the note-sharing concept we've previously discussed, extending the concept into sending messages whilst the author is mobile. Notes are created on an Android phone (see Figure 5.6). Focussing on the free-form notes, doodleMessenger also give users the ability to draw on top of photos stored upon the users' phone. We also wanted to explore whether other forms of sharing notes (beyond the sending of notes to a paired tablet and subsequently to a printer as in the MSD), meaning that we designed the software such that doodles can be sent privately (through MMS or email) or publicly (by being uploaded to Facebook or Flickr).

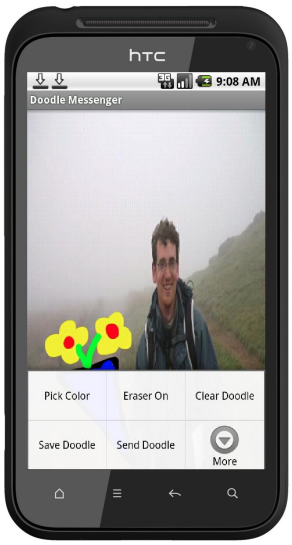


Figure 5.6: The DoodleMessenger Application

Having the different ways of sending the doodles – both privately and publicly – was a design decision about how doodleMessenger should implement the concepts of openness that we've discussed. People are used to having the option to share media publicly on their phones and it was a pragmatic decision to allow users the same ability through doodleMessenger. It has the additional benefit of allowing us to explore how people would deal with such choices and what type of messages would be sent publicly or privately and to whom.

The absence of the printing aspect of the MSD system has consequences with regards to the tangible and serendipitous elements of the communication system. The tangible aspect is completely removed from the system and the serendipity aspect is weaker, particularly as

mobile phones are already used as messaging devices. However, the advantage of removing the printer is that use of the system becomes a lot more available. Due to the hardware involved in the MSD, people could only send notes whilst at home (or wherever they choose to install the system). By removing such hardware elements, users can create doodles anywhere they have their phone and at any time. Although this was not considered a major design decision at the time (hence the absence of 'availability' in the shortly to be presented initial Design Space), the results from our interview studies reported in Chapter 6 resulted in 'availability' being added to our revised Design Space.

In addition to the convenience of being able to produce doodles at leisure, the availability also has a relation to effort. With the Magic Sock Drawer, we've discussed how effortful creating the notes can be. Due to the fixed availability of the MSD, this means that the effort must always be expended in the home. With the flexibility of doodleMessenger, effort can be expended when the participant chooses; presumably when they have nothing else to do or when thinking about their partner.

5.2.3 HotHugs

The HotHugs belt moves us on from the previous two devices in that the metaphor is significantly different, focussing on hugging rather than sharing notes. Previous work has looked at hugging as an inspiration for design, namely Mueller et al. [2005] who created a jacket which 'hugged' the person wearing it using compressed air. Although none of the participants wanted such a jacket, they "expressed that exchanging hugs was an interesting idea and that the tactile interface was fun" [Mueller et al., 2005, p. 1675]. There are two design changes which were intended to overcome some of the trepidation of Mueller's participants. The first was a change in the sensory medium. Although we wanted to retain a tactile sensation, the noise generated by the air-compressor turned a lot of people off the hug jacket idea. As such, we selected heat as the sensory medium. Heat was used for the additional consideration that minimal work has been undertaken investigating heat as an interaction medium for exchanging emotion [Lee and Lim, 2010] and we wanted to explore that within the belt.

Additionally, Mueller et al. report that "the couples also expressed that they missed some kind of mutuality (e.g. both partners wearing synchronized vests) because giving someone a hug is a two-way interaction" [Mueller et al., 2005, p. 1675]. We concluded that it was essential to make it clear at all times that there were two belts and each person in the relationship would have one.

The HotHugs belt is a development of the Thermal Hug Belt developed for my MSc thesis. The MSc demonstrated that between friends, under lab conditions, such a belt could increase feelings of social presence ([Gooch and Watts, 2010] and [Gooch, 2009]). We wanted to move beyond these methodological limitations and see whether a similar concept could help connect long distance lovers.

The resulting belt can be seen in Figure 5.7 and worn around someone's waist in Figure 5.8. The belt consists of a 'waist toning' belt – selected as it can be adjusted for the varying size of participants. The white squares visible in Figure 5.7 are Peltier devices which warm up when a current is passed through them. Due to power and weight considerations, the belt is connected to the mains electrical system through a control box which also controls the

electronics allowing the belt to be controlled from a PC. The other piece of hardware is the cuddly toy. These are selected by the participants themselves and then augmented with touch sensors such that when 'hugged' they send the signal to their partner's belt which warms it up for three minutes. HotHugs is intended to be used in conjunction with another communication medium, one which can deliver content beyond the tactile signal, for example Skype or IM.

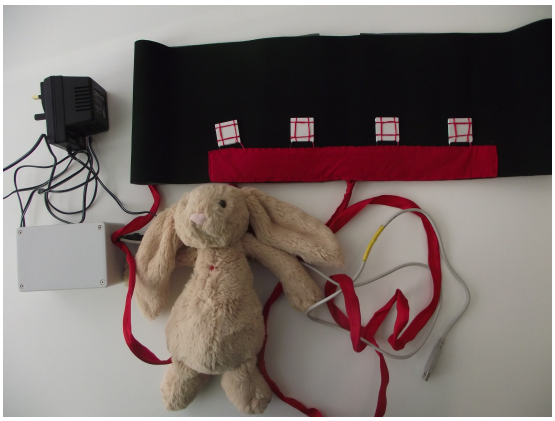


Figure 5.7: The HotHugs Belt

There were 5 design facets which were reflected on in the design of the hotHugs system. We have already stated that hotHugs was a departure in that it's metaphor is based around hugging. Believing that the way in which the metaphor is presented is important, we designed the hug belt such that it can be used in a variety of ways. This subsequently allows us to explore how the strength of the metaphor affects people's perceptions of it. The first method of use has already been described, of wearing the belt around the waist (see Figure 5.8). A second alternative is to strap the belt around a chair such that the heat pads can be lent against, getting the same feeling without having to wear the hotHugs belt (see Figure 5.9). The third alternative is to wrap the belt around a pillow and place the soft toy within the pillow. This allows you to squeeze the pillow to send the hug and you feel the warmth by holding the pillow against you (see Figure 5.10).

Personalisation again played a part in the design of the system. This may seem peculiar as every activation of the hug belt feels exactly the same. However, our concern with personalisation with this device was not on the content level but on a presentation level. When placed out on case study (see Section 9.5) we encouraged our participants to decorate the belts to remind them of their partner, using fabric paints, embroidery or anything else they cared to use. Additionally, participants selected their own soft toys as activation artefacts. These were deliberate choices, aimed at increasing user's attachment to the devices through the use of personalisation.

Mueller's investigations in the design of a hug belt focussed on using pressure as it's sensory medium [Mueller et al., 2005]. As we discussed in Section 2.8, the main shortcoming identified by the participants focussed around the use of pressure, particularly the noise involved. Given that a hug is primarily a physical act, we wanted to explore the way in which other tactile sensations could be used to represent a hug. Given that heat has been associated with emotional expression, see [Lee and Lim, 2010], heat was selected as a tactile sense which could connect LDDRs.

The hotHugs system is based on a one-to-one connection for similar reasons as the MSD; by restricting who can use the communication system we hope to increase the intimacy of each

Figure 5.8: The HotHugs Belt being worn

Figure 5.9: The HotHugs Belt wrapped around a chair

Figure 5.10: The hotHugs Belt wrapped around a pillow

act of communication. More interestingly, the hotHugs belt gives the opportunity to explore how a fleeting tangible experience fits within people's expectations. Unlike the notes produced by the MSD and DoodleMessenger, the warming up of the hug belt occurs only for a short period of time. This was deliberately designed as we are interested in how the choice between a fleeting or realised experience impacts upon people's ability to remember, relive, reflect and re-experience the feelings generated by an act of communication.

5.2.4 SleepyWhispers

sleepyWhispers differs from the other devices by using sound as the sensory medium that it operates through. Communication systems commonly use sound as a medium – telephones and video conferencing being prime examples. By using a loose interpretation of pillow talk as the design inspiration, we were able to design a communication system using sound without replicating existing systems.

sleepyWhispers is a way of sending recorded sound messages to your partner. They are listened to through a speaker, hidden inside a pillow. Messages are played with the listener presses the button embedded into the photo frame (see Figure 5.11). Messages can be recorded using any type of device (including on a PC or a mobile phone) as long as they are recorded in .mp3 format. The intended use case is that people record and send messages during the day to be listened to just before their partner goes to sleep. However, there is no technical barrier in the implementation preventing participants from developing their own usage pattern.

Figure 5.11: The sleepyWhispers Device

In terms of personalisation, the anticipated use case of sleepyWhispers was partners sending voice messages to each other; voice being fundamentally personal as we discussed earlier. Other messages could be sent of course but these could be less personal. The other way the system is personalised is through the photo frame which is intended to contain a photo of the person's partner; another subtle reminder of the connection between the couple.

The system contains one further detail based on our interest in fleeting and realised outputs. Like a real whisper, each message can only be listened to once; after which it is deleted and can not be listened to again. In this way the messages are clearly fleeting. However, while listening to messages, there is an option to download and keep the message, making them realised. This has both a practical and emotional outcome. Messages which are distorted and can't be understood can be downloaded and listened to again to ensure that they have been understood.

In emotional terms, messages which are particularly special can be downloaded and kept, to be re-listened to and enjoyed again. The intention was to explore whether restricting access to some messages made either the fleeting or realised messages more precious, as has previously been proposed [Thieme et al., 2011]. Again, there is no technological barrier to prevent users from downloading every message sent through the sleepyWhispers. There is a drawback to only playing the messages once which is what happens if there are no new messages to listen to? Given this design decision, we went against playing a notification sound, instead asking users to record an 'apology' message which played when there were no new messages for their partner to listen to, maintaining the personal connection created by the system.

The sleepyWhispers system has one further design facet built into it, namely openness. There are two sets of equipment, suggesting a one-to-one system. However, as the messages are sent through a web interface, there is no reason why users could not distribute that link more widely, allowing other people to send them messages. This is a development upon the openness theme as it gives us the ability to see whether participants choose to broaden the scope of the system. If not, this provides some evidence for suggesting that one-to-one communication does indeed have something special to recommend it to long-distance couples.

It is worth stating that the system is very similar to an answer phone. There are some distinguishing features. Not only is the environmental context different, messages are intended to be recorded. Conversely, answer phone messages are only recorded because the person could not talk to the person they were trying to call. Additionally, as with the MSD, knowing that the message could only be from their partner, the message is known to be relationally meaningful in advance of actually listening to it. Finally, the fleeting and realised options for listening to the messages are somewhat different to that of an answer machine. Previous work has highlighted that voice-mail can be made more intimate for LDDRs, notably the Love Eggs system [Kaye and Goulding, 2004]. sleepyWhispers also maintains a tradition of using the bed as a location for intimate communication, given the behavioural considerations of being in bed together [Dodge, 1997, Goodman and Misilim, 2003].

5.2.5 Hand Holding Prototypes

The final three devices were developed together with the express aim of exploring what a communication system based upon hand-holding could be like. The three prototypes we present are titled YourGlove, HotHands and HotMitts. They use different physical channels (e.g. movement or heat) to communicate intimate signals and thus present the same behavioural metaphor of hand-holding in three distinctive ways. To present the devices and design facets in the clearest way possible, we will first describe each device before going over each of the design facets wrapped into the hand-holding devices.

Within the HCI literature, there is a small amount work based around investigating hand-holding. O'Brien and Mueller carried out a technology probe investigating hand-holding [O'Brien and Mueller, 2006]. The only similar device of which we are aware is the handshaking system presented in [Alhalabi and Horiguchi, 2001]. However, there are some significant differences between their device and our aims. First, a handshake is fundamentally different from holding hands it is a different action with different emotional overtones. One is a greeting, the other of emotional significance. It is a rare business meeting which would involve the participants holding hands together. Second, the work in [Alhalabi and Horiguchi, 2001] uses a force-feedback

joystick. Our aim was to build custom communication systems to better understand the factors that would contribute to a good design.

In addition, there are at least two different focus groups that have suggested the building of hand holding devices [Kaye and Goulding, 2004, Vetere et al., 2005]. Although these designs did not go on to be built, the fact that participants requested such a device makes this area a compelling one to investigate. We build on this work by presenting three prototype devices that are based on the metaphor of hand holding before discussing how these devices explore different design ideas.

YourGloves

YourGlove is based around the movement of hand-holding (see Figure 5.12). The device is made up of a robotic hand controlled by strings which, when pulled, cause the hand to contract. YourGlove is mounted onto a tube, approximating the dimensions of a human forearm, and is controlled via a Phidget interface board. The device has the appearance of a limb that can be used to reciprocate hand-holding. Hidden within the back of the glove is a switch that, when pressed, causes an additional paired hand to close. The position of the switch is such that it is activated when someone holds their YourGlove. YourGlove is used by placing the hand within the glove, pressing the aforementioned switch. This sends a signal to the partnered hand making it contract gently around the partner's hand.

Figure 5.12: The YourGlove Device

HotMitts

HotMitts (see Figure 5.13) differs in that it uses heat rather than touch as the sensory medium, driven by a Phidget-controlled Peltier pump. Instead of mimicking a moving hand, HotMitts is based around the exchange of body heat which occurs when holding hands. Two hand imprints are used as the basis for the device. The device is used by placing one's hand into the imprint. If your partner's hand is within their imprint, both devices warm up together.

HotHands

HotHands (see Figure 5.14) again uses heat rather than movement as the key physical signal in the medium of the hand. The system consists of two model hands, each with containing a

Figure 5.13: The HotMitts Device

Peltier heat pump. Under each heat pump, a push switch is embedded into the hand. Using a Phidget control board, the heat pump can be controlled in software. When a person places their hand onto their model hand, the other person's model hand warms up.

Figure 5.14: The HotHands Device

Design Concerns

The three hand-holding prototypes were developed with one main purpose – to explore the metaphor of hand-holding as the design inspiration behind a device for supporting long distance couples. Each prototype varies in the strength of the metaphor. The YourGlove was intended to be as close to hand-holding as could be achieved with a tangible device. The HotHands device was the next strongest; although still physically modelled on a hand, the interaction is very different, weakening the metaphor. HotMitts has the weakest metaphor, being only loosely modelled on a hand and the interaction with the device being distinct from actually holding hands.

By having three different prototypes based on the same behaviour, we can compare how important the metaphor is compared to the underlying behaviour (see Chapter 6).

Having devices based so strongly on the human form could result in the devices being perceived as 'creepy'. Robotics researchers have struggled to find ways of realizing acceptable appear-

ance and behaviour. This is the well-known uncanny valley phenomenon, where high- fidelity androids can provoke feelings of revulsion [Mori and Minato, 1970]. Whilst increasing android fidelity initially results in more favourable human reactions, this trend becomes dramatically reversed as the ungainliness of robots ceases to look cute and instead is perceived as creepy' or weird'. Given that our devices are based around the behaviour of human hands, there is a possibility that they could fall within the valley. Thus one of our considerations for designing three distinct prototypes was to deliberately limit realism, to clearly establish which of a limited set of behavioural and appearance cues we would leverage. In this way we wished to gain insights into how far the metaphor could be developed before the device is rejected as being uncanny.

Personalisation was a key element of the design of these three devices. The YourGloves are designed to be personalized to the absent other by being dressed in a familiar glove, the sleeve of a top and jewellery according to its significance for the particular couple. This means it could gain a familiar and treasured feel, aroma, and appearance. By using clothing and items from the individual's partner, the aim is to create an association between the YourGlove and the partner. In this way, we hope to make the device more meaningful for the users of the YourGlove system.

The HotHands and HotMitts system share a similar system of personalisation. Both can be uniquely cast for the specific couple. In other words, the hands or imprints are cast directly from the couple's own hands. There are two levels to this type of personalisation. The first is that we envision a co-creation process - making the castings whilst on a visit or before moving away, and including the decoration or embellishment of the device as users see fit. This creation process could be a significant memory for the couple, recalled each time they use the device. Such a memory could imbue the devices with a special meaning; making them more special to use and increasing the feeling of presence when using them. The sense of 'one-ness' or 'we-ness' created by co-creating the devices is directly related to our conceptualisation of Closeness we discussed in Section 2.5 and the IoS measure of Closeness we discussed in Chapter 4. The second level is simply a decorative one. We have encouraged users to decorate them with paints and to carve into the devices if they so wish. This surface personalisation is again intended to create an association between the device and the person's partner.

The metaphor of hand-holding limited the selection of sensory media to those which the co-located behaviour utilises. Specifically, we had a choice between the movement of holding hands (as in the YourGloves) and the transfer of body heat (as in HotMitts and HotHands). Our perspective is also semiotic: that the physical signals are only meaningful when embedded in elements of the relationship. We conceptualize the interpretation of signals within a close personal relationship as a matter of establishing it as a personification of the remote loved one. The ambiguity in the signal supports the capacity of lovers to attribute meaning to the low-bandwidth communication provided by these devices. We again anticipate that the devices would be used with another communication channel, similar to the HotHugs belt. The openness of the system is, like the HotHugs belt, one-to-one.

5.3 Device Progression

The preceding Section may appear to simply list the details of the devices without constructing an argument as to how the designs progress or build upon one another. The reason for doing so is such that the details of the devices have been explained prior to discussing how the devices compare and contrast with one another.

Although we have presented the devices in turn, the development of the 7 different devices occurred over a 2.5 year period. In chronological terms, the hotHugs concept was first, being an extension of my MSc work [Gooch, 2009]. The MSD was second, utilising the bulk of literature on note-sharnig systems and resources owned by the department. My interest turned to hand-holding and the YourGloves, hotHands and hotMitts were designed in turn as informal feedback maked out YourGloves and hotHands as being somewhat creepy. The pilot case study presented in Chapter 7 was undertaken while the hand holding devices were being developed. Reflecting on the low-portability of the devices to that point (having moved to the USA for 3 months, placing myself in an LDDR), my attention turned to consider what a phone-based MSD may be like, resulting in doodleMessenger. Finally I recognised that sound remained an under-utilised medium and reflecting on those intimate behaviours using sound resulted in the concept for sleepyWhispers.

Based on our review of previous devices (see Section 2.8) and our attempt to examine couples' existing communication patterns (see Section 4.3) we already knew that we wanted to explore how personalisation, effort, sensory medium, tangibility and metaphor could be used to explore what a device based on co-located behaviours, intended to support LDDRs, could be like.

The way we have presented the devices makes it appear as though we designed all of the devices at one time rather than following a design–evaluate–redesign process. To a limited extent this is true and was a decision taken quite deliberately. The purpose of creating the devices was to explore what was possible and creating a series of devices assisted in pursuing that goal without having to concern ourselves about whether a particular design was 'good' or not. Similarly we wanted to explore which design facets became significant when facing the practicalities of creating the devices – for example, considering where to store the sleepyWhisper messages caused us to reflect on the significance of fleetingness in the design of communication systems.

Of course our design process was more nuanced than that. We were continually seeking the opinions of friends and colleagues to provide an informal light-weight evaluation of the devices. This caused both small design improvements (such as dressing YourGloves in clothes) and the construction of hotHands and hotMitts followed comments of 'creepiness' assigned to Your-Glove. Similarly, publishing out design concepts early allowed us to examine the opinion of the research community.

Such evaluations allowed us to clarify and refine our ideas. However this feedback came from people who were not necessarily in LDDRs. The pilot study presented in Chapter 7 convinced us to focus on the drawing interface for the MSD and to try an improve the reliability of message exchange. In Chapter 6 we present an initial analysis of these devices from people in LDDRs. If clear ideas about additional devices were found we would have considered implementing them. On a device level, decisions were made as to which devices to take through and evaluate within field studies (YourGlove and hotHands being excluded).

Furthermore, some detailed design decisions were made based on the responses from the interviews in Chapter 6. Foremost amongst these was the decision to make the connection between hotMitts hot only if both people's hands were in their device rather than the approach taken by hotHugs.

Table 5.1 shows how the various devices built upon the ideas of earlier devices.

Device	**Features**
hotHugs	• Primary concern was the hugging metaphor • The selection of heat was dictated by a desire for tangibility while avoiding the air pressure issues discussed elsewhere • Instead of the message-level personalisation of the MSD, wanted to explore personalising the device
Magic Sock Drawer	• Personalised notes through the creation process • Effort invested through the creation process • Tangible notes created through the printer • Revealed the potential to create serendipity through potentially hiding the printers • Through deciding how to store and exchange the notes we revealed the concept of openness
YourGlove	• Began with the metaphor of hand-holding • Tried to literally mimic the movement of hand holding • No other concerns in the conceptual stage
hotHands	• We recognised the creepiness of YourGlove and wanted to retain hand-holding as the metaphor • Given the successful implementation of hotHugs, we borrow the heating element concept • Retaining the idea of personalising the device itself, similar to hotHugs, settled on the concept of casting a hand • When writing the software we reflected on when to activate the heat, sparking our interest in reciprocity
hotMitts	• The realism of hotHands was still rather creepy. The driving factor behind hotMitts was to further decrease the realism whilst retaining the personalisation elements of hotHands, resulting in the hand-prints
doodleMessenger	• Starting motivation was to explore an always accessible version of the MSD • Have kept the personalisation and effort elements of the MSD notes • To increase availability, the printer has to be removed. This came at a cost with regards to tangibility and serendipity • Being phone-based, doodleMessenger also helped us to explore who people would like to share the messages with
sleepyWhispers	• Starting point was to use sound as the sensory media. The metaphor of pillow talk came from reflecting on those intimate behaviours which involve sound • Using voice messages was an extension of the message-level personalisation of doodleMessenger and the MSD • The facet of fleetingness vs realised messages appeared through having to decide how to store the voice messages

Table 5.1: Connections between the devices we designed

Throughout this discussion we should not forget the purpose of this thesis – to explore what design facets are significant when considering the design of communication technologies for LDDRs and whether devices based on those facets help to support LDDRs. The process through which we designed the devices was sufficient for this purpose, highlighting some meaningful facets of design and allowing us to explore the space of potential devices.

5.4 Initial Design Space

Thus far in this thesis we have used the term 'design space' without discussing in any depth what types of design spaces exist, what they are useful for and how they are validated. Given that we are about to discuss the design facets within our initial design space, we should first establish what we mean by our 'design space'.

It has been argued that the concept of having a design problem suggests that there is a single best solution, that the solution can somehow be measured and assessed. In all but the most trivial of design work, this view is no longer held – many designers subscribe to Rittel's view of *wicked problems*, problems which have no definitive formulation and no best solution, simply solutions which are good or bad [Rittel and Webber, 1973]. Such an argument leads us to consider how we can map out potential solutions.

Predominantly there are three types of design space: Generative [Jul, 2002, Truman, 2011, Robertson and Loke, 2009], Evaluative [Pinelle et al., 2003, Minhas et al., 2012, Nielsen and Molich, 1990, Molich and Nielsen, 1990, Vinson, 1999] and Conceptual [Westerlund, 2005, Aghaee et al., 2012, Lane, 1990, Mehandjiev and De Angeli, 2012, Patel et al., 2010, Graham et al., 2000]. As a brief aside, we must clarify that in this context, 'conceptual space' is distinct from its use in cognitive science where it refers to a theory of how knowledge is represented in memory [Gärdenfors, 2000].

Generative design spaces assist designers in producing designs which are 'good' for some measure of good. Generative spaces seek to predict what design elements and characteristics will produce a positive outcome. In comparison, *evaluative* design spaces predict the outcome that a given design would produce [Jul, 2002, Moore, 1997]. Generative and evaluative spaces are very similar in that both apply value judgements to the design facets within the design space. They differ in that a generative space starts with a design space and results in the design of a device. An evaluative space starts with a design space *and* a device and results in an assessment of whether the device is in some sense 'good'.

Conceptual design spaces have been defined as encompassing "all the possible design solutions" for a given problem [Westerlund, 2005]. However this definition does not distinguish necessity from coincidence; many design solutions may contain elements which are unnecessary. Although a conceptual space will contain many poor solutions, it will always be possible to add an arbitrary additional dimension which will extend the space of *all* possible solutions. There is a difference between those dimensions which are necessary for achieving some purpose and whether a design space is sufficient to arrive at some result. Other phrases used have included "depicting a landscape of the support provided rather than to evaluate systems as 'better' or 'worse"' [Mehandjiev and De Angeli, 2012, p. 36]. In short, a conceptual design space sets out the key functional and structural decisions made in creating a system design, classifying the alternative decisions that could be made. Lane [1990] describes conceptual spaces as:

> "Each dimension of a design space describes variation in one system characteristic or design choice. Values along a dimension correspond to alternative requirements or design choices... A specific system design corresponds to a point in the design space, identified by the dimensional values that correspond to its characteristics and structure" [Lane, 1990, p. 2]

Within this thesis we are developing a conceptual design space which attempts to focus on values rather than the accidental presence of the characteristics of any given design. The design space aims to map a number of dimensions which are useful when considering the design of communication technologies for maintaining long distance dating relationships. We produced a conceptual design space as this was considered to be the basis of both a generative and evaluative design space.

It is possible to turn a conceptual design space into a generative design space by formulating "design rules that indicate good and bad combinations of choices. Such rules can be used to select an appropriate system design based on functional requirements" [Lane, 1990, p. 1]. Similar rules would be necessary to turn a conceptual design space into an evaluative design space. Producing such rules are beyond the scope of this thesis. Such rules consider not only the value judgements applied to individual design facets but also how the facets combine and interact with one another. However, through a series of interviews (see Chapter 6) and case studies (see Chapter 9) we will consider the value judgements couples in long distance relationships ascribe to the facets in our design space.

The three different types of design spaces tend to be created in the same way; predominantly grounded in existing literature, theoretical background and empirical data, an individual collates knowledge together to formalise a space.

The three different design spaces tend to be evaluated in different ways. Generative spaces are tested simply by generating designs and assessing the quality of the designs. Evaluative spaces are tested by evaluating a succession of designs and comparing the results of the evaluation against some other measure.

Conceptual spaces are tested by demonstrating the designs can be placed within the design space. Mehandjiev and De Angeli [2012] provide a relatively comprehensive 'test' of their design framework by getting a number of experts to place their own (or favourite) mashup systems within the framework. In this context, an expert is someone with expertise in the field under consideration rather than having expertise in the design space. Although not termed as 'validation', Aghaee et al. [2012] demonstrate that their space is fit for purpose by placing current mashup systems within their design space. Graham et al. [2000] performs a similar validation using 'richly interactive systems'. We concur with the argument that it is not necessary to get experts to place systems within the design space; this requires a level of understanding and training to use the space which are more concerned with understanding the space rather that the validity of it. We believe it is sufficient to demonstrate, as Aghaee and Graham do, that a number of devices can be placed within the space.

Aghaee et al. [2012] concisely states what conceptual design spaces are useful for. Firstly, designers can use the space to foster innovation when creating new designs. Design spaces result in a "descriptive and exploratory tool for designers and to communicate and record their reasoning about potential interactive systems" [Graham et al., 2000, p. 406]. This is essentially

a practical contribution; designers can examine the design space and consider where they want to make cutting-edge changes.

Secondly, the comprehensive consideration of the various dimensions provides researchers with a novel design-centric view over the state of the art. This is primary a theoretical contribution, scoping out areas where further innovation could occur. As Graham et al. [2000] argue, by formalising the design space in this way, it becomes easier to consider alternative designs and the properties they could have.

Having discussed what design spaces are, how they are formed and why they are useful, we now turn our attention to our initial design space. Based on the devices, our analysis of the literature and the results of our study into Social Presence, we are in a position to propose an initial design space. The design space is a collection of concepts which we suggest are significant to bear in mind when considering the design and creation of a new communication system for long-distance partners. We make no strong claims about the concepts (e.g. personalisation is good) at this stage. Instead, the design space maps part of the conceptual space in which devices for LDDRs exist. Mapping the space allows researchers and designers to consider what previous devices have focussed upon and which areas are ripe for exploration.

The aim of this thesis is to support LDDRs through the development of communication technologies with high levels of Social Presence. It is now necessary to discuss how the design space helps us achieve that aim. We have already demonstrated that communication technologies have an impact on feelings of Social Presence and that these feelings have wider relational significance (see Chapter 4). What we don't know is what aspects of the design of communication technologies causes this impact on SP though the evidence suggests that it is not a simple sum-of-cues issue (see Section 2.4). The design space is an attempt to map out the facets of design which could be causing this impact on SP, though determining the exact relationship between design facet and SP is beyond the scope of this thesis.

We will now present each facet of the design space, explain what it means in terms of the design of a communication technology and why we believe it belongs it the design space, based on the literature and the reflective process of design which resulted in the creation of the devices we have just discussed.

5.4.1 Metaphor of Use

Metaphor concerns the nature of the message being sent through the communication system. A number of metaphors can be used to describe the various types of messages which can be sent. We described the three main types of metaphors in Chapter 2, arguing that the majority of devices can be classed as being ambiguous, object-augmentation or behaviour-based. We will now briefly reiterate the three metaphors for completeness.

The first type of system is to have a completely abstract communication system such as that presented by Kaye [2006]. This type of system requires the recipient to interpret the meaning of any message passed through the system. Kaye's system consisted of a desktop task-bar circle which changed colour dependent on how often the person's partner clicked on their circle.

The second approach is to augment an existing artefact. This type of system takes an existent artefact, such as a bed or a cup or a table, and supplement it with technology such that it can be

used as a communication device. A good example of this is from Goodman and Misilim [2003], who present an augmented bed, fitted out with features to communicate with a partnered bed.

A third approach is to attempt to replicate a co- located behaviour over a distance. This concept takes a co-located behaviour such as hugging, kissing or holding hands and tries to replicate it over a distance. This is the focus of this thesis and as such all of our devices fit within this category. That is not to say that the translation of a behaviour into a communication technology is straightforward. Both doodleMessenger and the MSD are based on exchanging notes but diverge in how they approach the other facets of design. Similarly, the hand-holding devices were specifically constructed to explore whether changing the strength of the metaphor had an impact above and beyond the selection of a particular behaviour to mimic.

5.4.2 Personalisation

With the digitisation of much of our communication, one of the factors which is quickly being lost is individuality. Each individual has a unique voice and style of handwriting, things which are identifiable by people who know that individual well. In contrast, all email messages or typed letters look the same regardless of who the author is. This contrast is what the personalisation factor encapsulates. Personalisation does not speak to the changing of fonts and text sizes. It describes communication which has a touch of the other person about it; an element of the communication is inherently linked with the other person. Devices can implement personalisation in several ways; by changing the level of openness (discussed shortly), by using a unique trace of the other person in the formulation of the message (e.g. handwriting) or through a process of creating the devices together. Through all of these different methods, the person's partner becomes manifest through the act of communication. Some work has indicated that personalisation and appropriation in this way can increase engagement, as found in the context of an interactive art gallery [Flint and Turner, 2011]. There are other forms of personalisation, such as utilising playfulness or idiomatic messages as discussed in Section 2.7.1, which operate on a content level and are subsequently harder to design for. We must also highlight that our description of personalisation is distinct from that used by researchers interested in the design of work environments [Wells, 2000] or personalisation of appearance [Blom, 2000, Monk and Blom, 2007]. We use the term to reflect the selection of cues which speak directly to a person's partner.

Although most systems now use standardised presentation (e.g. typed) there is no fundamental reason why this should be the case. While there is a case for it in terms of clarity and understandability, in terms of intimacy, abstracting out all personalised features is likely to be a mistake. Those systems which still use personalised features (such as face- to-face or telephone calls) are demonstrably higher in terms of Social Presence than those that do not (such as email or IM) (see Chapter 4). We have previously discussed how personal connections are important within people's communication routines (see Chapter 4) and how other designers have tried to utilise personalisation (see Chapter 2). Personalisation also offers people a chance to use their personal idioms within mediated communication. Given the link between relationship satisfaction and idiomatic communication, this could help support the distant couple.

Both email and IM are fairly standardised; that is they have few personalisation features. There is however no link between being digital and a lack of personalisation features of the nature we are discussing (e.g. excepting font colours etc.). The MSD is a case in point - despite being

digital, the drawing interface gives participants an opportunity to express themselves and embed personalisation features into their messages. Similarly, sleepyWhispers and doodleMessenger used personalisation in the content level of the communication. Conversely, hotHugs and the various hand prototypes were decorated in such a way as to remind the user of their partner regardless of the interaction through the device.

The concept of personalisation, as we've presented here, has overtones of the labour theory of value – that the real worth of something is the cost of the labour to create that something [Smith, 1776]. Making the effort to personalise an object involves a great sacrifice of time and is therefore a sign of greater value. Similar claims have been made by sociologists interested in gift giving claiming that "to give something is to give a part of oneself" [Mauss, 1954] and that "an object which is made by hand is not quite like any other object. It is unique, and carries the inescapable marks of the person who made it" [Cheal, 1987, p. 158]. Objects can mean more to an individual if they imbue qualities inherited from the sender. Kuruoka and Greenberg, as long ago as 1999, proposed that there was no reason why physical digital surrogates can't also imbue these properties [Kuzuoka and Greenberg, 1999].

The inclusion of personalisation in the framework should make designers think as to whether a standardised approach is actually the best one and stop them from assuming that it is the only option. Everybody is an individual with unique traits and our communication, particularly in an intimate context, should reflect this.

5.4.3 Effort

Recent findings have indicated that the effort invested in creating a message is appreciated by the recipient of that message. Riche et al. [2010] found that elderly people in particular found that new communication media (such as email) devalued the act of communicating as the media were too easy to use. In comparison, sending a letter was perceived as harder to do and was appreciated more. We found similar concerns in our analysis of Social Presence (see Chapter 4).

Riche et al. proposed that making interfaces harder to use (e.g. creating barriers for use) would thus be beneficial as people would appreciate the effort invested by the author. This is true in a subset of areas but does run the risk of creating frustration with the system if done in an unnecessary manner. The MSD has demonstrated that effort can be invested in such a way which is perceived as being of benefit by the recipient.

There has been an assumption in the HCI literature that ease of use is always good. The inclusion of effort in the design framework is intended to demonstrate that this is not always the case. In certain circumstances, considering increasing the difficulty of communicating using a particular medium could be of demonstrable benefit.

We should note that having to invest effort in creating a message is not necessarily the same as making it difficult to create a message. It can be done by offering an opportunity to invest effort or personalisation. It is not difficult to write a letter but it does require a level of effort. Based on an extensive interview and diary study of existing communication within family groupings, Romero et al. [2007] stated that "we found that the effort invested by the sender of a message is valued by the receiver, but only when it is *meaningful* with respect to the communication message". The investment of effort must be meaningful rather than wasted for it to be valued

– making someone solve sums before sending an email is not the same as encouraging people to handwrite a letter.

Effort can be deemed to be partly a social issue, partly a technological one. If we use the comparison between sending an email and writing a letter, the technological difference is that writing a letter arguably involves a larger degree of effort than typing out an email. However, an email can be sent instantly, whereas the letter has to be put in an envelope, addressed, stamped and then posted - all of which could be described as being part of the process rather than being specific to the technology (which is really writing). The question of effort then extends beyond the technologies involved but also encompasses the process of using the technology.

5.4.4 Sensory Medium

One of the things that is often overlooked when talking about communication media is the sense that it uses to communicate through sound, smell, taste, touch or sight. Although there are other senses - e.g. pain or balance - these 5 senses are the ones most used to communicate with.

When talking about the sense used to communicate, we mean the sense that a person uses to interpret and understand a message. For example, you listen to a telephone call (the sense used is sound), you read a letter (the sense used is sight). We are not talking about industrial design issues although we accept that they also have an impact on how people use and perceive a communication system. This concern relates back to the concept of message formulation we discussed in Section 2.7.2. The form/sense used within a message determines what can be communicated by that message.

Of current systems, nearly all commercially available systems use either sight or sound. Telephones primarily use sound; face-to-face uses both sound and sight; letters use both touch and sight; email uses sight. We established in Chapter 2 that in intimate communication systems, there is a move towards investigating the use of touch as a means of communication, especially as so many co-located intimate behaviours are based on touch (e.g. hand-holding, hugging, kissing). We also found that physicality and tangibility is an important part of how people communicate in our analysis of Social Presence (see Chapter 4).

Our devices have tried to utilise a variety of sensory media in order to explore the advantages and disadvantages of each. Ranging from touch and sight (the MSD with printed notes), sound (sleepyWhispers), heat (hotHands, hotMitts, hotHugs) and movement (YourGloves), our devices take advantage of tangible signals primarily because this is what co-located behaviours commonly involve.

Considering which sensory media to use is important. What you can say is constrained by the sense you are using. Therefore, considering which sense you are using, means you are also considering what messages you could send through the communication medium. We discussed this in great depth when considering how message are formed (see Section 2.7.2). Typically, touch is associated with the exchange of emotions (see Section 2.11.2).

5.4.5 Fleeting versus Realised Output

The penultimate factor to consider is the nature of the output of the communication. The output of a communicative act is the means used to communicate. For example, the output of a telephone conversation is the conversation, the output of a writing a letter is the letter.

These outputs can be classed as being fleeting or realised. A realised output is one which can be kept, something physical. Common examples are things like letters, text messages or emails. Fleeting outputs are those which happen for a period of time and then can never be recovered or re-lived. Common examples include telephone calls and face-to-face meetings. Some of these fleeting experiences could be recorded - recording a phone call for example - but there is still a difference in so far as the realised outputs were intended to be kept whereas recording a fleeting experience is keeping something in a form it was not intended for. Rereading a letter is substantially different to listening to a phone conversation you have recorded.

It is worth noting that a realised output is different from a tangible output it is possible to have a fleeting tangible experience. To illustrate this, we can compare two tangible systems. The hug belt we discussed in Section 2.8 from Mueller et al. [2005] creates a fleeting experience (i.e. the hug) whereas the MSD produces a realised output (i.e. the note). Our devices vary; the MSD, doodleMessenger and sleepyWhispers all produce realised messages, the hand-holding devices and hotHugs create fleeting experiences.

The design implication of this is that if the communicative acts performed through the medium are intended to be kept or relived, it seems sensible to design the system to create a realised output. If relying on memory is what is wanted, a fleeting output would be more desirable.

5.4.6 Openness of the System

The openness of the system describes who can communicate with whom when using the system. There are, in essence, four different ways openness can be characterised - many-to-many, many-to-1, 1-to-many and 1-to-1.

Many-to-many communication is the system that is most common in commercial systems. Given certain details, any number of people can contact you using the medium and you can contact any number of people back. For example, anyone can call your telephone (provided they know/guess your phone number) and likewise you can call anyone from your telephone. The same is also true of email and many other communication media. They are deliberately designed for mass-use; few people carry around a phone for each person they wish to talk to.

A many-to-1 communication system allows multiple people to contact you, but in such a way that you cannot respond to multiple people. Intercom systems often work in this manner, whereby anyone can buzz your intercom but you can only talk to that person. 1-to-many is essentially a broadcast system (such as radio or TV) where 1 person can broadcast a message to many people who cannot respond. These are less commonly thought of when communication media are discussed in the literature as they are not really used for personal, especially intimate, communication.

The final type is 1-to-1 communication systems. This means that only one person can contact you through the system and likewise, you can only contact one person. The MSD was specifically

designed to incorporate this level of openness as a design feature. So were hotHands, hotMitts, YourGloves and hotHugs. As a user of the system, only one person can send you a message (the person with the other device) and you can only send notes to one other person (the person with the other device).

We have also used a mixed model of 1-to-1 and many-to-many with the doodleMessenger system, similar to the sharing capability of many mobile devices. With sleepyWhispers we wished to explore the model a little further by making the communication 1-to-1 by default but allowing users to choose whether or not they would like to use the system more widely.

With many-to-many systems, you never know until starting the conversation whether you will be talking to your bank manager or your partner as everyone can contact you through the same system. Although there may be cues to inform you - caller ID for example - you still need to engage with the message and remember a lot of information to know who is trying to communicate with you.

With 1-to-1 systems you immediately know who is trying to communicate with you as it can only be one person. The supposition is that this can help to increase the intimacy of the contact. If you already know who is trying to communicate with you, this gives the message a heightened level of intimacy as there is no doubt about who the message is coming from.

Trying to create 1-to-1 communication can be seen behaviourally in some many-to-many systems - some people create a granularity of somewhere between many-to-many and 1-to-1 by using separate telephones for business and personal use. This behaviour is carried out despite the technology, rather than because of it. We are encouraging designers to consider incorporating such ideas into the actual communication system.

5.4.7 Contextual Factors

There are other factors that could have an impact on Social Presence, but which are not directly incorporated into the communication medium. One factor is the location of the communication activity - are you at home, at work, mobile? If it is in the house, whereabouts in the house? Where is the other person? The location of things are important, not least because of the context which surrounds the location. Talking to someone from your work telephone feels different to talking to someone from your home phone - even if the actual telephone is exactly the same. Concerns around intimacy and privacy have a direct impact on what people communicate, from where, using which particular technology.

Privacy is a major concern with any communication system. Rarely built directly into the communication system itself, and thus not part of the framework, it is clearly related to concerns around communication and is worth noting as an extraneous factor. For any communicative system to succeed, users have to be comfortable with the level of privacy the system provides for them.

A second factor is the speed of message exchange. How quickly the message is transmitted does not determine when the message is received. Some systems have an element of vagueness to them. For example, although the minimal time a first class letter in the UK takes to arrive is one working day, it can take any number of days to arrive. Likewise, an email can take milliseconds to actually send but it is unknown how long it will take until the recipient actually

reads it. It is unknown how this impacts upon communication. The supposition is that an unknown time to arrival could cause a sense of anticipation (from both author and receiver) and thus strengthen the sense of intimacy, if and only if both parties are privy to the sending of the message.

This factor is distinct from the concept of serendipity, the concept of the 'happy accident' of discovering an unexpected message. Although the speed of message exchange can be undetermined, if you are expecting the arrival of a specific message it, regardless of how long it takes to arrive, there is no sense of serendipity. Indeed, the anticipation of that message is almost the antithesis of serendipity.

The concept of serendipity, although designed into the Magic Sock Drawer, was not a major design driver, nor was it actively considered when designing the other devices. For these reasons, serendipity is not included in our Design Space at this stage of the thesis. In the next Chapter we shall discuss how our participants highlighted serendipity as an important issue, necessitating it's addition to the revised Design Space.

A third factor is gift-giving. Much communication can be characterised as a process of gift giving (Mauss, 1967). This creates a obligation to reply to messages, related in some ways to the speed of message exchanged and the messages involved. How much this affects the design of communication systems is unknown. For example, it is unclear whether having a system which does not allow instantaneous reply (i.e. limiting gift giving) would have a negative effect on the perception of the communication system. Conversely, allowing instantaneous responses might force an obligation to reply - and if a reply does not come, it could cause negative feelings.

In addition to all of the factors we have discussed in this Chapter, we should make clear that there is a huge amount of context surrounding every communicative act which is likely to have a substantial impact on feelings of Social Presence. Such things could include whether that person has had a good day at work; whether the weather is nice; whether the people involved have had a recent argument. Such contextual detail is extremely difficult to gather, let alone formalise into a design framework. As such we need to acknowledge that even designing the perfect communication system will not result in consistently high levels of Social Presence or guarantee the success of the relationship.

5.4.8 Summary

In this Chapter we have discussed the development of seven novel communication devices, based on the mimicry of co-located behaviours, aimed at supporting long distance dating relationships. These devices form the bedrock of our later studies, using them to explore people's views to certain design facets (see Chapter 6) and the impact of such devices on people's relationships (see Chapters 7 through 10).

Having discussed the design facets of these devices, we reflected upon our analysis of the literature and the results of our study into Social Presence in order to codify an initial design space which describes the conceptual space that these devices exist within.

In summary we have:

- presented our seven new devices, namely the MSD, doodleMessenger, sleepyWhispers, hotHugs, YourGloves, hotHands and hotMitts.

- proposed an initial design space consisting of:

    1. Metaphor of use
    2. Personalisation
    3. Effort
    4. Sensory Medium
    5. Fleeting versus Realised Output
    6. Openness of the System

The devices and Design Space, although grounded in the literature, have not yet been evaluated. In the next Chapter we present two interview studies which examines what people from LDDRs think about the design facets embodied in the devices we've developed within this Chapter. Based on these studies we iterate over the initial Design Space presented here to develop a revised Design Space which helps us to answer our second research question – RQ2: What design facets are significant when considering the design of communication technologies for long distance dating relationships?

Chapter 6

Exploratory Interviews and Refined Design Space

In the previous Chapter we stated that the devices were developed to explore both their impact on long-distance relationships and to consider the parameters of a possible design space in which to situate them. The development of the devices helped to clarify our thinking about LDDR specific design considerations; before deploying the devices into relationships, we wanted to explore what people's initial reactions to the devices were. As such, two interview studies were undertaken. The first looked exclusively at the hand-holding prototypes; as well as investigating the design of the devices, these initial interviews helped determine which device should be deployed into a case study. The second series of interviews were based around the other four devices and were exclusively concerned with exploring LDDR design parameters by reflecting on the properties of the devices.

Within this thesis we have defined Social Presence as "the degree of salience of the other person in the interaction and the consequent salience of the interpersonal relationship" [Short et al., 1976, p. 65]. We have focussed on this concept as a measure of how successful a communication technology is in supporting LDDRs (see Chapter 4). However, as we have previously highlighted in Section 2.4, there is currently no understanding of how different design decisions, embodied within communication devices, impact feelings of Social Presence. Within Section 2.8 we described our use of the terms 'emotional connectedness' which combines measures of Social Presence and Closeness within qualitative data to inform our understanding of how our devices might help support LDDRs. Within this Chapter we will outline how our methodology and results relate to the concept of Social Presence and emotional connectedness and thus how they might support LDDRs.

This Chapter presents these interview studies and based on the analysis of participant's responses, we present a revised version of our design space, intended to better answer our second research question:

> **RQ2: What design facets are significant when considering the design of communication technologies for long distance dating relationships?**

6.1 Initial Interviews

The initial set of interviews was constrained to the three handholding prototypes, YourGloves, hotMitts and hotHands, described in Chapter 5. There were three key reasons for this. Firstly, we wanted to select a device based on hand-holding, a strong behavioural metaphor, to deploy into a relationship through a case-study. We didn't want to deploy all three devices as the technology behind the devices was not sufficiently mature to guarantee performance and we did not have sufficient time to develop robust software for all three systems. Secondly, a pilot of this interview study suggested that presenting all seven devices in one go was too much for our participants; it took a long period of time, participants got distracted and their interest in the design waned. Splitting the prototypes into two sessions was a way of managing this. Dividing the devices between the sessions allowed a focussed contrast of hand-holding and other devices. Presenting the three hand-holding prototypes together gave us an opportunity to explore how people respond to the metaphor of hand-holding as the underlying behaviour for the device design, as well as the properties of each interpretation of the behaviour as realised in each design.

6.1.1 Methodology

Participants

12 people in long-term distant relationships took part in the study, 6 male and 6 female. These were 12 individuals, not 6 couples: that is, we interviewed one person from 12 different couples. People were recruited using online noticeboards and posters. Participants were paid £10 for taking part.

Data Collection

The prototypes were intended to explore the design potential around what it could mean to create a communication system based on behavioural qualities of holding hands. We wanted to gather data that would contribute to an understanding of the meaningful qualities of each prototype. To this end, we used a three-phase semi-structured interview process: (1) Introducing the design idea, together with a narrative scenario, (2) a hands-on demonstration of the prototypes device, and (3), a discussion to compare and relate their experience with each device in the context of their own romantic relationship (see Table 6.1). The rationale for this method was structured around an understanding that people's views may change depending on the way in which the devices were presented. The first phase was intended to gather participant's opinions on the ideas behind the device without focussing on any shortcomings of the prototypes. The second phase then allowed participants to reflect on these opinions having had the prototype device demonstrated to them. The third and final phase was designed to encourage participants to contrast the similarities and differences in the design of the devices in order to better reflect on which aspects they liked or disliked.

The questions were designed with an understanding of our conceptualisation of Social Presence and emotional connectedness. All three phases attempted to ground our questions in terms of the participant's own relationship such that they would consider how the device might be

used to connect them to their distant partner. By running a hands-on demonstration of the prototypes devices we attempted to mimic a single act of communication which participants could reflect on. Framing this demonstration in this way allows us to draw out views which may relate to our conceptualisation of Social Presence.

The scenarios were used to gather information about the differences in how people viewed the design facet and the actual prototypes. We wanted our participants to engage with the underlying design facet rather than any shortcomings in the way the prototypes had been realized. Along with our design variations on the hand-holding theme, we wanted to better understand the influence of partner uniqueness on the basic design ideas, based on the personalisation aspect of our initial design space (see Section 5.4). Scenarios were thus devised in two forms of vignette: device- and person-centred alternatives. Device-centred vignettes were based around giving and receiving a gift in the form of a new remote hand-holding device. Person-centred vignettes described the co-creation of a remote hand-holding device. The vignettes were designed such that the number of words and the ideas expressed were similar in both the person-centred and the device-centred vignettes.

The person-centred YourGlove vignette differed by making it clear that the glove to be used on the device was particular to the person's own partner, not just a standard glove. The system could also include other personal items such as bracelets or rings. The HotHands system differed by making it clear that the moulds were of the couples' own hands rather than a standard mould. It was also made clear that the moulded hands could be painted or decorated. Similarly, the HotMitts were differentiated by emphasizing that they were imprints of the couples' own hands rather than a generic imprint. HotHands and HotMitts also included painting and decoration by the lovers. By contrast, each of the device-centred vignettes discuss buying a present of a new type of communication device that the couple can try out. Example person-centred and device-centred scenarios can be seen in Figures 6.1 and 6.2 respectively. Complete versions of the scenarios can be found in Appendix C.2.

The presentation of the 3 devices was counterbalanced for order. For each order condition, 1 male and 1 female took part. Of these two, one got the person-focused vignettes and the other the device-centred vignettes, counterbalancing for gender. All Device-centred participants were finally introduced to the Person-centred concept in the final phase of the interviews, only after forming impressions based on the relevant device-centred vignettes.

Ethics

Ensuring that both interview studies were conducted ethically was important, especially as we were now asking participants to use our devices. Included in Appendix C.1 are the consent forms and ethical checklist used to ensure that the study was conducted in an appropriate fashion. Both forms were checked by the ethics officer within the Department.

To briefly run through the main concerns; The study included no hidden procedures and no deception was involved. Participants were informed about the data being collected and it was made clear that it would be recorded anonymously and could not be traced back to the individual. It was also made clear that the data would not be passed to any third party (including their partner) and were not being collected for commercial reasons. However, participants were warned that the results of the study may be published in an anonymous form.

General Opening Questions

- First thoughts on hand holding... do you miss holding hands while you are apart or not?
- Do you think you would or wouldn't use a system which represented holding hands?

First Phase – Concept and Scenario

- What are your first thoughts about the [x] system?
- Do you think this is a system you might or might not use? Why/why not?
- What do you like about the concepts behind the [x] system? Why?
- What do you dislike about the concepts behind the [x] system? Why?

Second Phase – Using the Device

- So having used the prototype, has your opinion of the system changed or stayed the same?
- Are there any features you thought you would like/dislike which having used you now disliked/liked?
- What, if anything, would you change about the device?
- If we changed the device by making it more/less personal [by doing Y] would you change your opinion of the device? Or do you think it would stay the same?
- What do you think about the way the device is activated? Do you think it would be better if it was activated together? Or do you think separate is better?

Third Phase – Comparison and Discussion

- Which of the devices is your favourite? Why? Why don't you like the others as much?
- What do you think about the overall idea of trying to support hand holding at a distance? Do or do you not miss holding hands while you're apart? How well do you think the devices I've shown you meet that goal?
- Are there other things that you miss more? Do you think those could be supported while you're apart?
- These systems are all content free and intended to be used in conjunction with something like IM or Skype, almost like an accessory. Do you use anything like that already? Do you think you would use such a system or not?
- Anything else you would like to add?

Table 6.1: Three-Phase Exploratory Process

P

YourGlove

Michael and Samantha are long distance partners. Having managed to meet up, their weekend together is coming to an end. Before parting, Samantha passes a gift wrapped box to Michael. “What’s this?” he asks her. “Open it and see!”. Unwrapping it, Michael discovers one of Samantha’s favourite gloves and one of her bracelets pulled over a dummy hand. “What on earth is this?” Michael exclaims. “It’s a YourGlove” Samantha explains “I’ve got one too. You decorate the hand with my favourite glove and then when we’re chatting we can use it to hold hands. When I hold mine, yours will close and when you hold yours, mine will close”. “I see” said Michael “That’s so sweet – it’ll be like holding hands when we’re apart”. “Exactly” smiled Samantha.

The couple part and we re-join them one dark evening several weeks later. We can see them chatting away on Skype, the personalised Yourgloves taking pride of place on their desks. Before we leave, we see Michael slip his hand into his YourGlove and Samantha smile as she feels Mike holding her hand.

Figure 6.1: The YourGlove person-centred vignette

D

YourGlove

Michael and Samantha are long distance partners. Having managed to meet up, their weekend together is coming to an end. Before parting, Samantha passes a gift wrapped box to Michael. “What’s this?” he asks her. “Open it and see!”. Unwrapping it, Michael discovers what looks to be a cool gadget nestled in tissue paper, a glove covered dummy hand. “What on earth is this?” Michael exclaims. “It’s a YourGlove” Samantha explains “I’ve got one too. It’s a new thing I found in town. When we’re chatting you can use it to hold hands. When I hold mine, yours will close and when you hold yours, mine will close”. “I see” said Michael excitedly “That’s so cool – it’ll be like holding hands when we’re apart”. “Exactly” smiled Samantha.

The couple part and we re-join them one dark evening several weeks later. We can see them chatting away on Skype, the slick Yourgloves taking pride of place on their desks. Before we leave, we see Michael slip his hand into his YourGlove and Samantha smile as she feels Mike holding her hand.

Figure 6.2: The YourGlove device-centred vignette

It was made clear in the consent form that participation in this study did not involve physical or mental risks outside of those encountered in everyday life. The safety procedures taken to ensure the devices were safe were explained at length with the participants.

Most importantly, it was made clear that participants had the right to withdraw from the study at any time. Informed consent was taken from each participant.

6.1.2 Results and Preference Analysis

All participant interviews took approximately one hour. The three-phases of the interviews were continuously audio recorded and then transcribed for analysis. These transcriptions were analysed using the thematic analysis process we selected during our methodological discussion in Chapter 3. Direct quotations from our participants are used to illustrate the themes and include the following participant identification code: [Px – yz]. x indicates their participant number, y whether they read the Person-centred or Device-cantered scenario and z whether they were male (M) or female (F).

In addition to the open-ended questions, we asked each participant to state which device was their favourite (see Table 6.2) and whether they could imagine using any of the devices in their own LDDR (see Table 6.3). We will discuss these preferences before moving on to consider the specific issues that were raised in response to our prompts.

The first thing to note is that all the prototypes were well received by at least some of our participants but the two casting-based prototypes were much preferred. This indicates that the design facets behind these devices have a role to play in long-distance relationships. Participants did report that hand holding was something they missed:

"Yeah, I think the holding hands is one part of it... if you're away every week for a long period of time... it's that intimacy, the subtle things, just holding hands is something you do miss" [P10 - DM]

Validating the idea of using hand-holding as an underlying behavioural metaphor for device design. Furthermore, participants felt that these prototypes went some way to helping deal with the distance:

"if these had been available at the start of my uni life knowing I had 5 years of long distance then I possibly would have considered one" [P9 - DM]

With the 'possibly' focussing around questions of cost and bulkiness rather than issues with the intrinsic design facets of the device.

Vignette Centered on:	**YourGlove**	**HotHands**	**HotMitts**	**Total**
Person	2	0	4	6
Device	0	4	2	6
Total	2	4	6	12

Table 6.2: The favourite device of each participant

We now consider the themes identified from our analysis of the interview transcripts.

6.1.3 Thematic Analysis

The transcripts were subjected to thematic analysis (as described in Chapter 3) to form a viewpoint on the interaction factors that were most salient to our participants. Two general themes are used to make sense of our participants experiences: emotional closeness, and practicality. Our main concern for supporting long-distance romantic relationships is directly addressed though the emotional significance of the designs for our participants. Practical issues apply across the devices and to communication systems more generally and have an important bearing on situations of use.

Along with describing the themes, using quotes from our interview transcripts to illustrate each, we also indicate how many of our participants raised that particular theme. This in itself provides a guideline as to how general the theme might be. However, we should bear in mind that other participants could agree with the theme but not have thought about it or spontaneously mentioned it in their own interview.

Emotional Closeness

Personal Connections

The subtle and phatic nature of touch was commended by our participants for helping to "bridge the gap" between them and their partner:

"its just the little physical thing and something like this wouldn't replace it but help bridge the gap..." [P11 - PM]

This links to the value that participants saw in the devices. Instead of traditional communication, exchanging news about the day, the devices were liked for "connecting" the couple. Eleven of our 12 participants talked about how the devices would help them to connect to their partner:

"I'm not sure why but for me there would be more of a connection there because rather than holding something which is fake (YourGlove), you're more putting your hand on a model of something which is creating a reaction on theirs is more like holding your hands together [discussing hotMitts]" [P12 - DF]

People are used to touching their partners; living at a distance prevents this. Couples can still talk to one another but they cannot touch – this is perhaps the most salient thing that changes when a couple start living apart. The tangible interfaces helped to support this change:

"You just feel the feeling of someone's hand so you feel safe and connected... so you'd associate that more than talking to someone or seeing them on Skype [discussing hotMitts]" [P7 - DM]

There was even a view that it didn't even matter what the device did - that it simply has to form a connection:

"it's more about forming that personal connection than the specific action" [P10 - DM]

One of the things that we wanted to explore in the interviews is what was the interaction model for the devices. They were configured as synchronous devices in our study - as one person put their hand into a device, the partner's device is activated. There was some variation in opinion on whether it might be better to use this synchrony differently so that both hands have to be

in their device before they are activated. This was of significance to our participants because it seemed to change the type of connection that they felt would be formed between them and their partner.

Our participants overwhelming preferred to have both people's hands on the device before it was activated because it formed a more personal connection:

"Making the link... the trouble is, if you put your hand in it and they haven't and it warms up, they can't really get anything from it... so when you're both in it, it probably works better... yeah, I think if you both put it in to form that connection... [discussing YourGloves]" [P8 - DF]

"Both of you would have to have your hand on because I think that's where the personal connection comes... [discussing hotMitts]" [P10 - DM]

However, it was acknowledged that doing so meant that an element of spontaneity was lost, that arranging the connection did devalue it:

"I was just thinking that and I don't think that would be as nice as then you'd have to arrange it... cause it's not like you'd both spend your evenings sat with your hands in it waiting just waiting for that split second featuring heat and holding his hand... whereas I suppose if you were just sitting there and it warmed up it would be nice... maybe... are you thinking that you just have to sense its warmed up by feeling or you could maybe put a light on it or something... [discussing hotHands]" [P4 - PF]

The suggestion is that having to use a hand from each partner formed a stronger connection, but if people choose to be spontaneous, some kind of secondary signal would assist this. Given the intention to use the devices in conjunction with technologies such as Skype or IM, this secondary signal need not necessarily be built into the device. We discuss this in greater depth shortly when considering 'channel complementarity'.

We also postulated the option of turning the system into an asynchronous one, a kind of tangible voice-mail. We suggested that the system would either consist of recording a short video message with a tangible signal or recording part of a video chat along with the tangible signal. Participants generally disliked this idea as it removed the connection aspect of the experience:

"I think that's, it is a good idea because as you say then it means you don't have to be there all the time although part of me thinks its slightly impersonal in a way because yes you've recorded the video for them and yes you've triggered the device to respond for them but you're not directly talking to them. In a way, I think this sort of device would work better if you were actually in your Skype conversation at the time rather than pre-recorded in a way... [discussing hotHands]" [P9 - DM]

Clearly the asynchronous nature of the tangible voice-mail was appealing but the cost of sacrificing the connection with their partner was too high for seven of the eight participants who expressed strong views.

Replacement

Having argued that the ability to form personal connections was a theme which encouraged people to use the devices, it is necessary to note that two participants were initially hostile to the devices, believing that they were intended to replace hand holding:

"I think it's trying to replace what it would actually be like to be holding hands with someone you're with... and it's not real... [discussing hotMitts]" [P6 - DF]

"Obviously it's not the same; you're not feeling as close to the person; you're not going to feel as special, you just see it for what it is, as a product, but not as a sensation [discussing hotMitts]" [P7 - DM]

It is noteworthy that both of these participants were reading the device-centred scenarios. When we came to question them at the end of their sessions about whether their opinions would change if the device was personalised, both started to view the devices in a more positive way. This indicates to us that the personalisation elements of the vignettes powerfully framed participants thoughts about the physical realization of the prototypes.

Metaphor

Generally our participants were able to understand the devices as pointers to hand-holding experiences, as a way to form a connection between the couple while they are apart.

"this is just like feeling closer to someone by almost using holding hands as an inspiration but not trying to imitate the same concept of holding hands but what holding hands represents [discussing hotHands]" [P3 - PF]

Nine of our participants talked about the different metaphors that the devices were based around. More people would use, and favoured, the devices with the weaker model of hand-holding, the HotMitts and HotHands systems. The stronger the metaphor, the more problematic it seemed to be for our participants to differentiate the sentiment of the behaviour from the realization of the device. The YourGlove was repeatedly described as being "creepy" and even the HotHands were less accepted than the HotMitts:

"the unfamiliarity people have with just seeing a limb lying around... and I think it's very familiar to see a hand print, and I suppose it's more common and less innovative for people to either dip their hands in paint and put it on the wall or whatever... [discussing hotHands]" [P5 - PM]

"just because the imprint it's not something that would be attached to a body whereas these you expect them more to be attached or it's weird to take a part of the body off and have like a dismembered hand or arm or whatever... [discussing hotMitts]" [P3 - PF]

"I think it's good because [HotHands] was trying to be a hand which it clearly wasn't but this acknowledges that it's not a hand, it's just an imprint so in a way it's not like trying to trick you into thinking about it... other than that, same as the other one I guess... it doesn't look as nice but it doesn't really matter what it looks like" [P11 - PM]

The strength of the metaphor helped to determine how "creepy" people found the particular device. In addition to the presentational side, two people described the movement of the YourGlove as being unnatural:

"what I was getting at originally was that it just sort of jerked into place and it wasn't a smooth progression, it didn't feel like a hand, it's shaped like one but doesn't feel like one... maybe if it was more natural it would help" [P1 - PM]

"same as the other one, softer would feel more hand-like... would be easier to get over" [P11 - PM]

This too contributed to the feeling of 'creepiness' about the YourGlove. Additionally, there was also a practical strand to this thinking. As one participant said:

"I think I prefer the warmth over the movement because whatever you do, it's never quite going to be the same as an actual movement of your hand.. whereas that you can more simulate something..." [P8 - DF]

This clearly relates back to the uncanny valley we were discussing when describing the creation of the the hand-holding devices (see Chapter 5). Those devices which tried to copy the behaviour most closely (in this case, the YourGloves) most directly violate expectations of fidelity. Alternative ways of presenting the essence of a behaviour are likely to be more successful. That said, in one particular Device-centred case, the weak metaphor was seen as a weakness:

"maybe that seems a bit less personal, its nice again that it's controlled by your partner, but... on the other hand it's sort of, you could just be sat there thinking oh this is warming my hand up rather than thinking I'm sitting there holding my partners hand... [discussing hotMitts]" [P9 - DM]

It may be enough to convey the envisionment of a behavioural design through a compelling narrative, based on a familiar behavioural experience, as long as it has a simple, direct connection to a tangible facet of that experience. In this instance, our participant points out that heat is inherently less like hand-holding than movement. What keeps it within the realms of believability is the fact that the devices are physically modelled on the lovers' hands.

The acceptance or not of a particular metaphor is a difficult thing to design for. Simply going for the lowest common denominator, that which would be acceptable to everyone, runs the risk of forming a weaker connection between the users of the device. Relating that to our own designs, as the process for creating HotHands and HotMitts is essentially the same, simply a different cast, any deployment could easily see participants choosing themselves which metaphor they themselves wish to use. As we will discuss, memories played a significant part in people's treatment of the different devices. Allowing users to select which cast they make would have the additional advantage that if people had significant memories based on either of these designs, they could opt for that particular system.

Interaction

An unexpected theme which emerged was that of interaction. Three people discussed the heating devices in terms of how little interaction there was, how passive the communication channel is. Two of those found that the interaction provided by the devices was not enough:

"[hotMitts is not] pliable in terms of use... I could only put my hand in it in that position and no other, I couldn't change it at any point in the future, I couldn't do anything else with it." [P1 - PM]

"I think sort of from my point of view with hand holding, it would need to be a bit more dynamic [discussing hotMitts]" [P9 - DM]

The alternative viewpoint was that you only needed a small additional interaction to an existing channel to make the system worthwhile:

"I guess it's a nice idea, adds a little more so when you're talking on the phone or on Skype, instead of just hearing their voice, you've got that little bit of interaction... yeah which seems

like a good idea... I mean if it were available I'd definitely go for it [discussing hotHands]" [P11 - PM]

To a certain extent, interaction can be described in terms of the metaphor behind the device – the interaction with the YourGlove is stronger as the metaphor behind the device is also strong. It remains a separate theme to highlight that different people want to communicate in different ways. Not all participants saw value in the phatic connection that the devices produce.

Tangible

Three people commented directly on the fact that the prototypes were based on touch:

"I think it's cool to feel a touch thing, I think that's, to know they're touching something is quite cool [discussing hotMitts]" [P2 - PF]

"yeah it sounds interesting... so just the warmth itself sounds quite fun [discussing hotHands]" [P10 - DM]

"although I haven't actually missed holding hands, its still kind of contact isn't it which I think is a nice idea... [discussing hotMitts]" [P4 - PF]

This is worth noting as it indicates a generally positive attitude to touch-interfaces as with regards to communication technologies for distance partners. We acknowledge that touch interfaces are novel and that this will have an impact on how they are perceived by participants. Regardless, the opinions we have seen are indicative that touch is a sensory medium worth investigating as an interaction technique. This corresponds to our discussion of the literature which indicated that haptics are well suited to emotional communication (see Chapter 2).

Personalisation

Personalisation was one of the themes than frequently came up in our interviews, 11 people mentioned it; those who read the person-centred scenarios delighted in it; those who read the device-centred enjoyed the concept more when the personalization idea was raised:

"maybe because that's a bit more personal... if that were the case, and its made for each of us, it would be really nice to have and maybe I'd actually consider having it, yeah, I think it would really make a difference... [discussing hotMitts]" [P6 - DF]

There seemed to be three distinct strands that caused personalisation to be liked so much. The first is that by being able to personalise the device, it was associated more with their partner. This seemed to be important as it formed an additional connection to their partner as the device was customized to remind them of that individual.

"it should represent him, so if he painted it boring colours that would be fine, that's what I'd have on my desk. But yeah, it should represent them [discussing hotMitts]" [P2 - PF]

"[while discussing YourGlove] I like the whole bracelet idea especially cause like I have this bracelet and my partner has the same one and we've had them for like four years so although it's like a pound and worthless to anyone else, there's some sentimental value that means we just don't take them off... so I think that's quite a powerful thing actually..." [P5 - PM]

This reminder of their partner directly corresponds to our definition of Social Presence

The second strand was that of uniqueness. No one else has your handwriting but everyone (nearly) uses the same fonts for emails. You use the same phone to talk to your bank manager as you do to your lover. The unique element of these designs seemed to appeal to people:

"Yeah definitely, because just like a mass produced hand has got nothing personal about it, there's nothing special for you or the person you're with, it's just something everyone else has, it's not unique [discussing hotHands]" [P11 - PM]

We found that the process of casting HotHands and HotMitts was considerably liked. The casting would create something unique and that the effort invested in it would make the device more sentimental:

"you wouldn't have any qualms about throwing it away... whereas if it's someone who's made it, I always feel a bit, like cards and even letters, something someone's written or made or when little kids have painted you something, even though you can't keep it forever, you always feel really bad about throwing it away or getting rid of it... so even if you didn't use it, like you'd still have it on your desk [discussing hotMitts]" [P3 - PF]

The final strand that seemed to contribute to people's feelings of personalisation was that of effort. Previous work has indicated that interfaces which require more effort can, sometimes, cause the receiver to value the communication act more [Riche et al., 2010]. Our participants seem to concur with this assessment but at a different level; the effort that had gone into the creation of the device was definitely appreciated. Whether this appreciation would continue when actually using the device is unknown:

"it's always nice when you have something handmade by someone else, that they put effort into it and you always appreciate that... [discussing hotMitts]" [P3 - PF]

The fact that the personalisation seemed so strong could, as one participant pointed out, actually be a downside. They argued that the personalisation would remind them of their partner. Because the devices were modelled on a co-located behaviour, they thought that this would simply remind them that they couldn't actually hold hands:

"Yeah I see, like customise it so it's more like your partner... I suppose that would definitely make it much more personal device so like then you would look at it; then on the other hand that could be quite creepy in a way; like sort of just the arm of your partner in your room... some people might find that a bit strange and actually they might find that a bit emotional in a way, especially if like being in an long distance relationship, if you see things that remind you of your partner, that could be quite hard [discussing YourGlove]" [P9 - DM]

We have previously identified personalisation as an important aspect of note-sharing systems (see Chapter 2). What this analysis indicates is that the personalisation of devices can be just as significant as the personalisation of content. Although personalisation often requires a degree of effort, it is worth noting that the concepts are distinct.

Evocation of Memories

As well as being an act of personalisation, the process of casting the hands created a significant memory of a shared experience that connected the people within the relationship. As our participants said, this memory would subsequently be triggered each time the device was used, making the couple happier and imbuing a sense of attachment to the device:

"the process of making is important because I imagine they'd be quite fun to make, because the activity is done together, it's a shared memory, so I think each time that you would go to use the system there would be a triggering of the memory of making the cast which I imagine would be a positive memory so that would then influence your mood in a positive way I think [discussing hotHands]" [P5 - PM]

This illustrates something we did not expect; the power that evoked memories brought to bear on people's attitudes towards the hand-holding devices. Five of our participants talked about memories and connected them to their use of the devices. These memories came in two types – personal memories that were associated with the device and broader cultural memories that made the devices seem less weird. One participant was particularly keen on the HotHands system as it reminded her of an early, but significant, memory within her relationship:

"it reminds me off a personal memory, just of being in the cinema, it's such a long time ago, I think it was on our second date and my hand was here and he put his hand on mine and I don't know just for me, perhaps not other people, that's why I liked it and when I saw it I thought 'wow' [discussing hotHands]" [P6 - DF]

One participant recalled an activity they did on holiday, and related it back to the imprint in the HotMitts system:

"we kind of did it when we went on holiday in the sand, it might have been feet, and then like wrote our names in the sand and took a photo of that so that's kind of a similar concept I guess..." [P3 - PF]

Others related the devices back to cultural stereotypes including the imprints in concrete of celebrities' hands in Hollywood and finger painting as children:

"you know like when you're a kid and you make hand print things and take them back to your parents..." [P2 - PF]

The cultural memories were useful in so far as they demystified and helped people understand the aim behind the design facets. However, what we are really trying to achieve is to tap into those deeper personal memories which were accompanied with a visceral attachment to a particular device. If we can find a way to access this visceral attachment within the communication act then the connection between the couple will be strengthened and hopefully better supported.

Weirdness

All of our participants, at some point, described one of the devices as being 'weird':

"[the YourGlove] it's a bit creepy" [P6 - DF]

"[the YourGlove] it's quite a nice idea but for me I think it would be a little bit strange" [P12 - DF]

"I think I might just get freaked out by it, randomly [talking about the hotMitts]" [P8 - DF]

"[talking about hotHands] just because the imprint it's not something that would be attached to a body whereas these you expect them more to be attached or it's weird to take a part of the body off and have like a dismembered hand or arm or whatever..." [P3 - PF]

The first thing to note is that weirdness is not necessarily a bad thing; it is simply a way of describing something which is not of the norm. Indeed, this describes many different innovations. That said, weirdness is clearly something which people associated with our devices and must be something we contend with.

A closer analysis of the 'weirdness' comments indicate that all bar 3 of them occurred after reading the scenario and before using the prototype. That is, all of the comments, not just

those which we've used for illustration here. In most of those cases their opinion changed after using it. The numbers in Tables 6.2 and 6.3 bear this out; people would not choose to use a device which they continued to find weird.

From this we can draw a methodological point. The change in opinion supports our commitment to the use of the prototypes in addition to the scenarios. It suggests that people are unused to making judgements about technologies without experiencing them, making it necessary to develop a prototype before trying to assess what it's likely reception will be:

"[discussing yourGlove] yeah, it was more creepy when I read about it" [P7 - DM]

"[discussing yourGlove] I suppose it's difficult to judge it until you've tried something like it" [P9 - DM]

This links to the methodological flaw we observed in Section 2.8 regarding the lack of evaluation in many designs. If you don't assess these devices, how can we know which aspects work and which ones do not? At the same time, the possibility of experimenter effects cannot be discounted. Participants may have been more reticent to criticize an invention than a description.

Practical Themes

In addition to the themes which had an emotional impact, there were a number of themes which revolved around the practical deployment of these devices, including biomechanical fit, mechanical noise, the possible abuse of the unique lover's channel and the viability of hand-holding devices alongside other media.

Biomechanical Compatibility

The first concern was to do with the simple fact that people have different sized hands. Eight people discussed how best they could actually use the cast hands:

"well no, actually because this is odd, imagine if my hands were really big and my girlfriends hands are tiny, that still works in real life, but here it's like your putting your hand into a mould of a hand that's not yours so it wouldn't fit. So like that finger there doesn't feel comfortable because it's not resting in there. So even though it sounds odd, it might be better to have a cast of your own hand [discussing hotMitts]" [P1 - PM]

As P1 correctly surmises, couples can have different sized hands and for the participant with larger hands, the device may be uncomfortable. That led to the concept of not swapping imprints. That concept had different concerns:

"I think I'd find it weird if it was an imprint of my hand because I'm just holding my own hand [discussing hotMitts]" [P8 - DF]

This suggests that this kind of decision should be left up to individual couples. Whether they choose to be more comfortable or to form a closer connection, it seems to be a personal decision for the couple.

Mechanical Noise

Only one of the devices caused noise due to the motors in it - the YourGlove system. Four participants complained about the noise that the YourGloves made. As one said:

"the mechanical noise is a bit odd as it reminds you, you couldn't like close your eyes and pretend it was them because I'm pretty sure [my partner's] hand doesn't go [buzzzzz] [giggles]..." [P2 - PF]

And another:

"I'm not too keen on the noise but obviously the noise has to be there, doesn't it... the noise makes it more robot-like which makes it less human-like..." [P12 - DF]

Similar findings were reported by Mueller et al. when discussing their compressed air hug-belt [Mueller et al., 2005]. It seems, perhaps unsurprisingly, that any kind of noise which distracts people from the moment stands to ruin the communicative act. As tangible devices continue to be experimented with, this is something the design community needs to be aware of.

Channel Abuse

A concern that a two people shared was that somebody other than their partner might use the system, either deliberately or by accident:

"I might have misunderstood but if I didn't then the one thing that stood out was, it is essentially, nothing stopping another person putting their hand in the device... if you're not currently having a conversation with your partner, at the time, through any other medium of communication, then they could potentially be, you partner could be under the false assumption that you're trying to communicate with them when actually it's not... [discussing hotMitts]" [P5 - PM]

"if you can see them and see that it's them using it rather than some other person who's hacked into the system and started holding your hand with a stranger... [discussing YourGloves]" [P3 - PF]

Such concerns are quite distinct from the issue of who you can use the communication system with, described within this thesis as 'openness'. Openness was not a theme which was discussed in relation to the hand-holding prototypes, possibly because it is hard to conceive of using them in any configuration other than one-to-one.

The concern seems to be with the possibility that using the system could create issues with their partner by thinking that they were using the system with their partner when in fact they were using it with someone else. Additionally they thought they might use the system without their partner being there. The relationship problems that could stem from either of these situations are clear.

Channel Complementarity

Using the devices with an additional communication system was seen as a plus. Not only did it help overcome the concern of other people using the device, the ability to integrate the prototypes into people's existing communication practices was considered a major positive:

"the personal aspect but also the way that you can combine the device with other communication devices is quite a nice idea... so the fact that you could be on Skype or a phone, you don't have to be using a technical device; as long as the actual device is in the room with you, you could be using pretty much any method of communication even I suppose you could argue, you could have both of you in the room together and you could still both have a device and do it... so I think that's quite a cool thing to have... [discussing hotMitts]" [P5 - PM]

Such concerns relate to our discussion of how touch needs to be supplemented with other communication channels to be meaningful (see Section 2.11.2).

One participant travelled a great deal and as such was concerned about the portability of the devices:

"the portability too I suppose, it's not something that's... it doesn't seem too sort of cumbersome, something that you have to wear; you could potentially just carry it with you... so if you travel a lot, you could take this with you, it's nothing which is too restrictive in that sense... so I think its very convenient; it can be used with multiple communication tools [discussing hotMitts]" [P5 - PM]

In that respect, HotHands and HotMitts have a clear advantage over the rather bulky YourGloves.

Practical potential

What these practical concerns tell us is that creating designs based on a familiar intimate behaviour is not straightforward. Although the metaphor is extremely powerful, it is by its nature almost unique to individual relationships. Designing something that provides meaningful interpretation for all potential users is challenging, and thus an approach that leverages small, familiar behaviours could have wide applicability.

This interview study was very successful in terms of getting an understanding of people's reactions to our hand holding devices and their underlying design facets. As such, we ran a similar study using the devices not included in this first interview study. The discussion of the thematic analysis from both studies, and their relation to our initial Design Space are combined in Section 6.4: the Revised Design Space.

6.2 Secondary Interviews

The second set of interviews used the four prototypes not used in the first set of interviews – sleepyWhispers, hotHugs, the Magic Sock Drawer and doodleMessenger.

6.2.1 Methodology

Participants

We used the same set of 12 participants that took part in the first interview study. The reasons for doing so were twofold. Firstly our participants are now accustomed with the process and the initial uncertainty surrounding novel communication devices. As such, we were hoping that we would gather more information on the underlying design facets and less discussion about superficial surface phenomena. Secondly, by using the same set of participants we could explore how these prototypes compare to the hand-holding devices. Participants were paid £5 for taking part in the study.

Data Collection

We used the same three-phase semi-structured interview process as for the first interview session: (1) Introducing the design idea, together with a narrative scenario, (2) a hands-on demonstration of the prototypes device, and (3), a discussion to compare and relate their experience with each device in the context of their own romantic relationship. We used the same broad set of questions as in the first interviews with three modified questions (see Table 6.4).

We previously discussed why we used scenarios and the reasons for using both person-centred and device-centred versions. Finding that this procedure worked well, we continued using two types of vignette without any modifications other than tailoring them to the specifics of each device.

The person-centred sleepyWhispers vignette differed by making it clear that the messages consisted of the partner's voice. The photo-frame part of the system could also include a photo of the person's partner or some other situation which is special to the relationship. The hotHugs system differed by making it clear that the belts could be decorated to remind the user of their partner. Additionally, the selection of the soft-toys by the couple was highlighted, indicating that they could represent either their partner or the relationship more generally. The Magic Sock Drawer scenario differed in how the notes were created (drawn or typed) as well as highlighting that the printer should be placed in a personal location. Finally, the doodleMessenger scenario focussed on the personalisation of the doodles. Complete versions of the scenarios can be found in Appendix C.3.

The presentation of the four devices was counterbalanced for order. For each order condition, 1 male and 1 female took part. Of these, one person got the person-focused vignettes and the other person got the device-centred vignettes, counterbalancing for gender. Each individual got a different scenario type from the first interview session. All Device participants were finally introduced to the Person-centred concept in the final phase of the interviews, only after forming impressions based on the relevant device-cantered vignettes.

Given that we used the same participants it is necessary to briefly discuss the meaning of the device-centred and person-centred scenarios. At no stage in the study are participants informed that there are two types of scenarios. Admittedly, it is possible that the device-centred participants in this study were primed to consider personalisation given their past experiences. The person-centred participants for this study would only have been introduced to personalisation in the broad sense in the previous study, not knowing the details of the personalised scenario. In general then, although participants might have been aware of personalisation in a general sense, the specifics of the vignettes may still allow us to draw distinctions between the different sets of participants.

Ethics

The same ethical concerns which guided the set-up of the first interview sessions (see Section 6.1.1) were also deployed during the second set of interviews.

6.2.2 Results and Preference Analysis

All participant interviews took approximately one hour. The three-phases of the interviews were continuously audio recorded and then transcribed for analysis. These transcriptions were analysed using the thematic analysis process we selected during our methodological discussion in Chapter 3. Direct quotations from our participants are used to illustrate the themes and include the following participant identification code: [Px – yz]. x indicates their participant number, y whether they read the Person-centred or Device-cantered scenario and z whether they were male (M) or female (F).

In addition to open-ended questions; we asked each participant to state which device was their favourite (see Table 6.5) and whether they could imagine using any of the devices (see Table 6.6). In addition to the favourite devices listed in Table 6.5, 1 person had no clear preference, liking aspects of each (a Device-Centered person). Three others (all Device-centred) wanted to combine elements of doodleMessenger and MSD and listed that as their favourite. We will discuss these preferences before moving on to consider the specific issues that were raised in response to our prompts.

Similarly to the first set of interviews, all the prototypes were well received by at least some of our participants. The note drawing systems were particularly liked. This indicates that the design facets behind all these devices could have a role to play in particular long-distance relationships.

Vignette Centered on	**YourGlove**	**HotHands**	**HotMitts**
Person	3	6	5
Device	0	5	4
Total	3 (25%)	11 (91%)	9 (75%)

Table 6.3: Devices participants 'would use again'

First Phase – Concept and Scenario • What do you miss about your partner while you are apart? Hand holding, hugging etc.? • Do you think you would or wouldn't use a system based on those behaviours?
Third Phase – Comparison and Discussion • What do you think about the overall idea of trying to support human behaviours at a distance? How well do you think these devices meet that goal? • If you would like to use this device, who do you think you'd want to use it with?

Table 6.4: Second Interview Three-Phase Exploratory Process

Vignette Centered on:	**sleepy-Whispers**	**doodle-Messenger**	**MSD**	**hotHugs**	**No Preference**	**MSD and sleepy-Whispers**
Person	1	2	1	2	0	0
Device	0	1	1	0	1	3
Total	1	3	2	2	1	3

Table 6.5: The favourite device of each participant

Vignette Centered on	**sleepyWhispers**	**doodleMessenger**	**MSD**	**hotHugs**
Person	(4)	5	5 (1)	2 (2)
Device	3 (2)	6	6	[2]
Total	9 (75%)	11 (91%)	12 (100%)	6 (50%)

Table 6.6: Devices participants 'would use again' (maybe) [depending on metaphor]

As we will go on to discuss, the devices were again liked for their ability to create personal connections between people in the relationship.

There are two things to note about the interviews. In the thematic analysis of the interviews, there was no split between practical and emotional themes, our participants only focussing on the emotional side of the devices. Whether this is an artefact of using the same participants again or because of the design on these particular devices or something else entirely we can't tell.

The second thing to note is that people's opinions were not as firmly held as they had been in the first interview study. This is perhaps best highlighted by sleepyWhispers:

"perhaps this is something that needs to be tried to work out whether you like it or not... I liked the look of it but when I heard it it seemed better than I thought..." [P1 - DM]

"I'd like to try the pillow because I'm curious to see whether I'd like to use it" [P1 - DM]

People were uncertain about the use of the system, as indicated in Table 6.6 by the 'maybe' values (contained in brackets). Similar 'maybes' were found with the hotHugs system:

"[discussing hotHugs] I think it's hard to know what it would be like without trying it out I think... it's... hard to imagine because it's so abstract, it's not, it's quite removed from, voice and pictures are ways you're used to communicating with but you're not used to communicating via temperature..." [P3 - DF]

Part of the uncertainty is undoubtedly due to a lack of confidence about what messages they would send through the device. No such issues were found with doodleMessenger:

"I can imagine myself drawing on images that we'd taken together... or on images of people that we both know and sending those..." [P1 - DM]

"I could see situations where I would use it; just when you see funny things that are part of an in-joke or whatever" [P3 - DF]

This highlights the limited insight we can gain from these interviews; participants can't experience them within their own communication and relationship situation. We acknowledge this as a limitation but argue that it has only minimal impact on people's ability to discuss the design facets behind the devices. Chapter 9 of this thesis go on to report on longitudinal studies of these devices in people's relationships, giving us greater ecological validity but at the cost of introducing concerns other than design – technical flaws and usage patterns for example.

We now move on to consider the key themes identified from our analysis of the interview transcripts.

6.2.3 Thematic Analysis

Once again the interview transcripts were subjected to thematic analysis (as described in Chapter 3) to form a viewpoint on the interaction factors that were most salient to our participants. Although efforts were made to focus on the content of the transcripts without referencing the results of the first set of interviews, the results cannot be considered to be independent of the first interview study. Given that we used the same set of participants we must consider this study to be an extension of the first set of interviews. Ten themes are presented, from Behaviour to Sensory Medium.

Along with describing the themes, using quotes from our interview transcripts to illustrate each, we also indicate how many of our participants raised that particular theme. This in itself provides a guideline as to how general the theme might be. However, we should bear in mind that other participants could agree with the theme but not have thought about it or spontaneously mentioned it in their own interview.

Behaviour

One of the most significant themes which we identified is that of behaviour; 5 people talked about the devices in respect of existing behaviours. There was a consistent view that mimicking co-located behaviours was a nice thing to do:

"in a way it's really nice to try and mimic those actions because it's something you can have while you're not together, even if it's not to the same standard..." [P6 - PF]

"[discussing sleepyWhispers] I think it's a nice idea... it's nice when I get an answer-phone message from [my partner]... not that he leaves loads, but if I haven't answered the phone it's nice if he's left a message 'oh, I've missed you, sleep well' rather than a text which says the same thing..." [P3 - DF]

"I do send notes and things so like when it was Valentines Day I was down in Bath... and so before I left I cut out a heart shaped piece of paper and I wrote 'I love you on it' and I sprayed it with my perfume and I left it on the bed on a toy that he bought me for valentines day a few years ago... so that when he went up to bed he found it and it smelt of me... so maybe you could send smells! I was trying to personalise it to make it better so put my perfume on it and he didn't notice so I got a text saying 'thank you' so I had to say 'smell it! Does it smell of me'... so yeah, I do leave notes behind so I can see that kind of thing but maybe you can't like leave it sitting on the bed and sometimes I just doodle notes when I'm sat next to him in bed and give it to him... but then it just becomes a coaster or something... so I like the idea of sending notes because I do do that" [P2 - DF]

Whether that concept of it being a 'nice thing to do' relates back to creating feelings of Social Presence or Closeness is not yet known. What we can say is that using co-located behaviours as the inspiration for our devices seems to have been a positive thing to do and was generally well received. This is reflected in the number of people who indicated that they'd be prepared to use either the hand holding prototypes (see Table 6.3) and the other prototypes (see Table 6.6).

One of the most important behaviours is that of 'Shared Experience'. People spoke of the routine of living their lives together, something which is impossible to achieve at a distance. Four people discussed this, including two people who did not talk about other behaviours as being significant.

"Being in close contact... watching things together and spontaneous activities like getting out of bed at 11pm to get them a McDonalds because they want one... shared experiences... companionship it would be I think..." [P1 - DM]

"it's also little things about sharing experiences... when we're at home we do the same things, eat the same things, listen to the same music - so while you're apart you want to share what you're doing..." [P2 - DF]

"the other bit I miss is spending time together which you can't replicate..." [P9 - PM]

As our participants identify, Shared Experience as a general aspect of intimate behaviours would be difficult to replicate in any kind of communication device. Some work exists in this area, for example Social TV (see [Harboe et al., 2008b,a]), but tends to focus around creating larger communities rather than connecting individuals. Other research has indicated that some people try to replicate a sense of shared experience by having an open Skype link during an evening [Greenberg and Neustaedter, 2013].

Some of the behaviours that people miss are already seen in the practices that they perform. Four people talked about sleepyWhispers in terms of their current practices regarding sending good night messages and the value these messages hold within their relationship:

"you quite often ring up people before they go to bed or text; it's quite nice to have it as a specific thing to do in bed... and you miss people a bit more when you go to bed..." [P2 - DF]

"and I think long distance partners tend to speak to one another just before they go to bed all the time anyway so I can definitely see how it would be frequently used and definitely more value added than just a text message before you go to bed..." [P5 - DM]

One participant discussed the similarities between doodleMessenger and the now defunct shared whiteboard in MSN.

"I like this idea... Me and my partner used to do this on the old MSN on the whiteboard... until MSN wasn't the done thing... but I think that's a really nice thing" [P4 - DF]

Being able to position our devices in terms of existing behaviours or practices has significant benefits. Our participants' accounts suggest that these behaviours and operating these practices fulfil some need, be it a Social Presence, Closeness or more generic emotional need. It may indeed be a need that we have not considered. This is of significance when it comes to considering our devices as they appear to fulfil similar needs to these behaviours and practices, such as through forming personal connections.

Personal Connection

Similar to the findings from the first interview study, forming a personal connection through our devices is important to our participants. Seven of our participants spoke of this. One of the ways the devices helped to create this connection was through the ability to indicate that you were thinking of the other person, both on a system and a message level:

"[discussing sleepyWhispers] it's a really nice idea as a present because it's something to give that shows you're thinking about them and it's something you can keep on using" [P6 - PF]

The other theme focuses on the resemblance between using the device and activities that you perform while together:

"I think there is a separation with the other person and you're trying to form a connection... with the belt you can see them on Skype and then you get the warmth, that feels like a natural thing... the note left for you on a bench feels like a nice thing to do, a nice thing to find..." [P10 - PM]

Even those participants who were not keen on certain devices, particularly the hotHugs, could see value of the device by the fact that it helps form a more personal connection:

"sitting on Skype is the tyranny of the distance relationship really so I guess it's an improvement on that" [P1 - DM]

Replacement

Replacement was raised as a concern by a participant who did not consider it as a theme in the first set of interviews. There seemed to be two levels to this judgement about replacement; the first was whether the devices we were discussing would encourage a change in the communication technologies they use:

"[discussing sleepyWhispers] a weird sort of talking pillow when I've got a phone so I can't see it replacing that..." [P11 - DM]

Additionally, the participant couldn't see themselves using some of the devices as they didn't form a personal connection and it instead felt like they were interacting with a 'machine'. This negatively impacted upon their opinions of the devices, concerned about replacing their current behaviour. The way that they seemed to determine whether or not the device was a viable addition was through how comfortable they were with the action:

"I guess if I wouldn't do it with a complete stranger then I wouldn't want to do it with a machine... I wouldn't go up to a stranger and hug them or hold their hand but I might leave them a note..." [P11 - DM]

This issue is related to the theme of openness which determines who can communicate through the system. We will present how this concept was discussed with regards to our devices shortly.

In the first interview study, some of our participants seemed concerned that the aim of the devices was to replace the action they were modelled on. Such concerns were not found during this study. One potential explanation for this is that the first set of interviews grounded the participants in what we were trying to achieve and therefore such concerns were no longer relevant.

Metaphor

Our participants again understood the devices as a proxy for the behaviour they are mimicking, recognising that the value comes from forming that personal connection. Ten of our participants spoke of metaphor in some way.

Separate from the metaphor behind the device, one of our participants frequently compared the devices to other, more familiar, technologies. This helped them to understand what the devices can do:

"[discussing sleepyWhispers] it seems more like an answer message in your bed which could be fun..." [P1 - DM]

While not directly concerned with our design interests, it is interesting to note that the use of metaphor assists in helping to explain what actions the devices perform.

In the first interview study, we set out to explore metaphor through the three different hand-holding devices. In these interviews, instead of using multiple devices based on the same behaviour, we used a single device and discussed the multiple ways it could be used. As we discussed when presenting the device (see Chapter 5), the hug belt could be used around the waist, around a chair or around a pillow.

Our data indicates that the way that the device is presented still has a significant impact on how accepted it is by users. The waist-wearing version of the belt was generally less popular:

"it sounds like an OK idea... I don't think it's much like a hug... I don't know how you could simulate that but hugging is kind of around the top... like having something around your waist... [P4 - DF]

Whereas the pillow version was much more popular:

"the pillow I think that might be quite interesting... because you'd be able to squeeze the pillow and your partner's pillow would warm up... so I don't know, the pillow sounds like quite an interesting one... depends on the heat which comes out of it, especially with a pillow which warms with your heat anyway..." [P10 - PM]

"yeah I think that I would definitely prefer it that way." [P11 - DM]

The behaviour of the belt remains the same in either case. This suggests that metaphor is doubly significant; not only on a device-level (what does the device do) but also on a presentation level (how does it do it). In other words, a device can have a familiar form and/or perform a familiar function. Various factors fed into the preference for the pillow version; reciprocity (which we will go on to discuss), the strength of the metaphor and a level of disquiet around wearing the belt.

Eight of our participants expressed some level of concern about wearing hotHugs. The major reason for this concern was simply one of weirdness:

"if you put that on, it's like putting your weirdo suit on..." , [P1 - DM]

"I don't know if it's just a bit weird that you're wearing something that gets warm..." [P8 - PF]

"I think it's just the idea of it being around you is a little bit strange..." [P12 - PF]

There were also practical concerns:

"[discussing hotHugs] I don't want to put this on, it's quite a faff.." [P2 - DF]

Not wanting to lose the moment by putting the belt on or preparing for the hug by already having the belt on were seen to diminish the value of the communication. This concern has overtones of surprise and serendipity; not wanting to break the moment indicated that people would not be surprised by using hotHugs simply because they need to prepare the communication device.

By comparison, the pillow version of hotHugs was widely liked; possibly because it fitted with the concept of appropriating objects, that the pillow held both a familiar form and function. This was something which eight people discussed across both hotHugs and sleepyWhispers:

"[discussing sleepyWhispers] I liked the way it was disguised as an object; that was cool... although I don't keep a photo frame near my bed, I know people that do so it was quite nice that it was appropriated, you just have a button on the object..." [P1 - DM]

"[discussing sleepyWhispers] I think I prefer it because the pillow and photo frame are two things you'd have in your bedroom anyway... so it's not really having to have anything else which makes it more natural..." [P12 - PF]

"[discussing hotHugs] one of the reasons I liked sleepyWhispers was, like I said, they're things that fit into your natural environment that you use anyway whereas this certainly isn't" [P5 - DM]

During our literature review, we described how devices could be loosely classified as being based on abstract themes, behaviours or objects (see Section 2.8). Our data doesn't suggest that our participants prefer particular devices because of the augmentation of a particular object. What it indicates is that the metaphor is best presented through objects which people already own. This, in addition to the wearing issue, is why people preferred the pillow over the belt version of hotHugs – people already have pillows in their rooms, they don't tend to have warming belts. We have made it clear that our classification is not discrete and there is some degree of overlap; our data suggests that considering where within the classification to design for is of significance.

We believe that the MSD and doodleMessenger were not discussed in these terms as the technology was not appropriated; people are used to the concept of printing from PCs and using apps on mobile phones. The metaphor in these cases is more about what the software achieves than the physical properties of the particular device.

Reciprocity

A reciprocal communication system is one where it is possible to send a message back to the person who you have just received a message from. Within this thesis we will consider symmetry within the reciprocity theme; in other words, is it possible to send a message back in the same form that you received the message? This is assisted if the metaphor being used is consistent in both the sending and receiving of messages.

Four people raised this as being an issue, particularly for hotHugs – regardless of the user's view of the hug belt, they commented that the generation of the hug didn't feel much like a 'hug'. In other words, the initiator of the connection doesn't feel like they are getting anything from the connection:

"I suppose if you both had one but it's not an act that you're both doing together... there's a difference between what you do and what you get... I think if I was on the other side and I did that, I'd feel a bit detached from the sensation that the person with the belt would be getting..." [P7 - PM]

"I think it's nicer than having a button to press because that's still less... but it's still not really anything to do with hugging - like it's so small, you'd need a human-sized bear to be hugging it" [P4 - DF]

This could explain why, in part, the pillow version of hotHugs was more preferred than the belt version – a pillow can be squeezed which is more like a hug than stroking a soft-toy. Reciprocity was of sufficient importance to our participants for them to discuss it.

Openness

Openness was not raised as an issue during the first set of interviews; this is perhaps unsurprising given how difficult it is to conceive of using the hand-holding devices in any other way. Conversely, as Table 6.7 shows, opinions differed as to how the various devices should treat openness. In other words, when discussing with participants who they would like to contact through the system a variety of opinions emerged. Some people preferred only being able to communicate with their partner (Closed), others wanted to communicate with anyone at all (Open). Some people wanted to have a finer-grain level of control, being able to communicate with selected friends and family (Mostly Open/ Semi-Open) and finally some participants stated that they simply wouldn't use the device with anyone.

Level of Openness	sleepyWhispers	doodleMessenger	MSD	hotHugs
Closed	9	1	6	8
Open		9	2	
Mostly Closed	3	2	2	2
Semi-Open			2	
Wouldn't Use				2

Table 6.7: How open participants wanted the devices to be

The devices were generally separated between the note-sharing systems and hotHugs/sleepyWhispers. The latter devices were widely viewed as being best set up as being 1-to-1. The reason matched what we aimed to achieve; by making the connection only available between you and your partner, the value of the connection is increased:

"[discussing sleepyWhispers] I suppose there's a few reasons... the first reason is I wouldn't necessarily give up a good night message to anyone that isn't my partner so that's one point... any communication I do with other people is done during the day, so I wouldn't necessarily think of this as a way of communicating there... it seems very personal so I don't think it should be open to use with a lot of people and I think there's definitely in my mind geared towards an intimate relationships than a friendship relationship" [P4 - DF]

"[discussing hotHugs] it just loses that connection that you have" [P7 - PM]

Of course people don't only want to feel socially present or close to their partners; openness is not a clear cut issue. Participants made reference to a variety of non-dating relationships as well as to their boy/girl friends. This is evident in Table 6.7 with the categories of 'mostly closed' and 'semi-open'. This was particularly the case with parents, particularly at times of emotional distress (e.g. illness or homesicknesses). This could be particularly emphasised within our population group of students; parents will still fulfil an emotional role which for other populations is more likely to be filled by a spouse:

"[discussing sleepyWhispers] I don't know; my mum could send me a message... it's a way of sending a message before bed, only for my mum I guess... maybe just my boyfriend, I'm not used to speaking to my mum before I go to bed but if I was ill or something..." [P2 - DF]

"[discussing sleepyWhispers] I don't know... probably not... maybe your mum and dad if you're feeling really homesick... It's coming through a pillow... at home I always say goodnight when I'm at home, and when you're little they are always the people you say goodnight to... so maybe as a comfort thing... but other people don't tend to be hanging around your room before you go to bed..." [P8 - PF]

In comparison, doodleMessenger was perceived as being a device which was more suited to being open:

"I can see myself messing around with it, sending it to your mate or whatever with a joke or to your girlfriend, flexible..." [P11 - DM]

"That one might be something you'd send to other people as well... because it could be something like to joke around with your friends, that's something I do more with my friends than I do with my boyfriend... I think if I sent him something he'd be like "what's that" whereas with your friends it'd be a more fun waste of time [giggles]" [P12 - PF]

There seem to be two underlying reasons for this. The first is that doodleMessenger is installed on a phone, a device which is already used to connect an individual to multiple people. Secondly, the content that doodleMessenger produces is quite different; people could see ways in which it could be used beyond forming a personal connection between them and their partner.

The Magic Sock Drawer sits somewhere between the two extremes; the content is similar to doodleMessenger but the printer imbues the system with a bit more specialness:

"Probably not, just cause the printer thing, in the personal space... the doodle thing I'd use more like a text message thing but this is a different thing because the printer makes it a bit more personal..." [P8 - PF]

This could account for the mix of opinions we've seen.

Personalise

Personalisation was again evident in our interviews with 10 of our participants mentioning it. The fact that personalisation was discussed is not a finding in itself since our interviewees were explicitly cued to think about personalisation through the study process. However, some finer-grain considerations emerged. The first set of interviews revealed three strands to personalisation; this set has reaffirmed one of these and indicated a fourth. The reaffirmed strand is that of device personalisation, associating the system with their partner to create an additional connection within the relationship:

"[discussing hotHugs] And it's the whole personalisation side of things... I think I'd be very against it if it wasn't personalised, because it would just be a belt which warms up... because it's personalised it's better" [P9 - PM]

The new strand is that of personalisation within a message, be that in the presentation (e.g. using voice) or the content (e.g. the use of personal idiom within a note):

"[discussing sleepyWhispers] I like the voice, the personal bits of it... you also get like a reminder of them, I think it makes it a bit more personal in a way because you can connect voice and face..." [P8 - PF]

"[discussing doodleMessenger] Definitely about sending a personal message to [my partner], and the fact that you can take a photo and draw on top of it which is a bit more than just a free-drawn message... so the photo is something I would do..." [P10 - PM]

Surprise and Anticipation

Surprise was something which we deliberately designed into the MSD system. Seven people talked about the element of surprise, overwhelmingly positively:

"it's nice to be surprised, that kind of element is good, whereas every night I expect [my partner] to ring me, it's not a surprise..." [P3 - DF]

One of our participants insightfully commented on the creation process:

"[discussing the MSD] one thing, this demo is you get to see the print out immediately which is fun... if you don't, if you do it really, they get it printed out so that would be different... you might get the excitement about anticipating them finding it but no immediate response... but then the waiting to find them..." [P2 - DF]

During the interview, participants were asked to imagine themselves as both the creator and also the receiver. What the above quote appears to illustrate is that not only is the surprise of

receiving a note considered a nice design facet; the anticipation the *author* has of their partner finding the note is considered beneficial.

Of course, in the MSD the element of surprise comes at a cost, namely the availability of the device:

"[discussing doodleMessenger] less of the finding nature of it with the printer but at the same time you'll get it whenever, so it's a quicker response, you get it straight away but you're less excited about getting it" [P9 - PM]

Availability

The availability of the device was an issue which 5 of our participants spoke of. It speaks to a desire to communicate at times of the relationship's choosing, much as we found communication management to be significant in current communication practices (see Chapter 4):

"[discussing doodleMessenger] I quite like this idea, I think it's quite a good idea... you still get a chance to send those kinds of notes and you can send them no matter where you are or whatever time of day it is..." [P8 - PF]

"[discussing the MSD] with doodleMessenger, you'd see something which inspires you to do it... whereas this is like, I don't know what would inspire you to use it..." [P3 - DF]

This desire for being able to communicate at times and locations of the user's convenience, as doodleMessenger achieves, without losing the element of surprise of the MSD, led 4 of our participants (three of which are distinct from those who talked of availability) to discuss combining the two devices together:

"if there was some way of doing the phone thing and using the printers, that would be the ideal situation... you can do it on the go but you still get to print it out" [P4 - DF]

"If somehow that was able to be done, where you could send from anywhere to the printer, that would be the best" [P5 - DM]

This is indicative that the situational availability of the technology is something that should be drawn into our thinking for LDDRs. The constraint of availability could be used either as support for serendipity or to create positive anticipation for both sender and receiver.

Sensory Medium

The tangible aspect of the MSD, namely the printing of the notes, was something which our participants delighted in, with 7 of them commenting upon it:

"I like the fact that you print the note out; that it's not just on the phone that you've got something you can put somewhere..." [P2 - DF]

"having the printouts was nice because it was separate... but when mobile, I don't think you need them printed... it might be considered more throw-away... but it's fun for that reason" [P1 - DM]

There was less discussion from our participants about the sensory media used in the other devices (heat, sound and sight). This could be acceptance by default – as there was no consistent discussion about any of the media types, all were considered to be appropriate to help connect distance partners. Those comments we received were more about clarification than the emotional impact:

"[discussing sleepyWhispers] I think the idea that you can incorporate voice into it is a really nice idea..." [P5 - DM]

"[discussing hotHugs] I was imagining it more of, I know it doesn't say in the description, I was imagining it more of a squeeze as well as the heating sensation" [P7 - PM]

6.2.4 Reflections on Hand-Holding

As we discussed earlier, by using the same participants in both interview studies we could contrast what our participants thought about the hand-holding devices and the devices in this study.

hotHugs was generally compared to the hand-holding devices based on the interaction that they all provide. Of the 10 people who had opinions on the differences between the devices, 2 preferred the heat-based devices. Both of these participants focussed on the personal connection that the devices provided:

"I think the belt would be the best at reducing the issue of being in a distance relationship..." [P9 - PM]

"The hug one is the only one that's comparable... the messages and the pillow seem to be a different sort of connection... my personal preference is the placing of hand on something (the imprint) I'd probably use that over the belt..." [P10 - PM]

The other 8 participants preferred doodleMessenger, MSD and sleepyWhispers. There were two driving factors behind this preference. Our participants could see how these devices could fit into their current behaviour:

"much as you miss the physical contact, when you've been together for so long, it's the little things you have, the little nuances and sharing experiences which over a short period of time, I miss most... especially if you can add a little bit of humour to them..." [P2 - DF]

"I think I prefer these [new devices] than those [the hand-holding devices]... [they are] more practical in a way... the hand holding ones you have to be there and using them at the same time... these you can use them wherever and whenever you want... they fit more into your routine of life..." [P8 - PF]

Additionally, the richness of the three devices was preferred over the relative paucity of the heat-based devices:

"they're much better, I like these more... except the belt... they're more, you do more with them rather than just sitting there..." [P4 - DF]

"I think they're a bit more rich in what they communicate so like you could... the other things would, you'd definitely need another set of communications, even that day – just the one where it heats your hand, that wouldn't be enough for the contact for that day... whereas say I couldn't speak on the phone that day, one of these might be an alternative for that..." [P3 - DF]

We now move on to discuss some of the broad general discussion points of these two interview studies before combining the thematic analyses to revise our design space.

6.3 Discussion

Using two types of vignettes within these studies was a methodological decision which was intended to explore whether participants would respond to the devices differently if they were framed in a personalised or generic way. In general, we have observed no major differences in the views expressed by either set of participants.

The only consistent minor difference between the two sets of participants revolved around replacing the mimicked behaviour with the device. Two device-centred participants were concerned about replacing hand-holding when considering each of the hand-holding devices, one device-centred participant expressed concerns around sleepyWhispers and hotHugs. In all three cases our participants were reassured that the intention was to supplement existing behaviours and technologies with these new devices.

Additionally, we observed that when the device-centred participants were introduced to the idea of personalising the devices, all participants, for all devices, liked the concept more than when it was not personalised. Given the lack of any themes which emerged from our analysis which were dependent on the device-centred vignettes, we would encourage others to frame their discussions in terms of how the device would actually be used within the person's life (in our case, framing the device in a personalised way using the person-centred vignette).

In the second interview study we mentioned how the metaphor behind the MSD and doodleMessenger was less about the physical properties of the device but more about what the software achieves. These two devices are different from the other prototypes as they demonstrate how behaviours can be mimicked through general purpose devices (i.e. PCs and mobile phones) rather than constructing a specific-purpose device. One implication of this is that our participants were possibly more favourable towards those devices based on general-use (see Section 6.2.2), possibly because they view these systems as being more realistic. However, we cannot be certain whether this is an artefact of the nature of the system (general- or specific- use) or the design of the device more generally. More broadly, we should also note that the MSD and doodleMessenger highlight that behaviour-based devices do not need to be based on the exchange on tactile signals. Although many of the behaviours we have focussed on are physical in nature (such as hugging or holding hands) couples express their affection in a huge variety of ways – shared experiences being one such example highlighted within this study. Our findings indicate that devices should be developed across the range of different types of behaviours rather than focussing purely on physical behaviours.

The value of this Chapter lies between reflections on design sketches and field trials; we argue that meaningful contributions to the interaction 'design conversation' can be made at various points along a continuum between design studies and 'real world' trials. A focused user-involved design activity of this kind in advance of situated evaluations has helped us to refine the design model and surface additional user concerns. Although field trials reveal critical information about actual use, it can be difficult to tease out problematic elements of a design concept from immersion in the detail of everyday experience. In this study our aim was not to collect information on how participants used our devices but to use the devices as embodied artefacts to explore design themes relevant to long distance couples.

In this context, the use of thematic analysis to analyse the focussed interviews is a minor contribution of this thesis. It demonstrates that thematic analysis can be used in a meaningful

way when attempting to discover pertinent elements of a design independent of it's actual use. In this case the gathered themes also refer to specific elements of device design rather than concerns about how the device was used within a field study. This is also a novel use of thematic analysis and one which we have demonstrated can be successful with both sets of interviews revealing themes which are meaningful in the context of design.

Participants' short exposure to the devices, and lack of use within their own relationships, are clearly limiting but retain value when recognizing that the focus is not on evaluating the devices but exploring the design concepts embodied within them. Field trials are irreplaceable in the longer term: indeed we will go on to describe how our the devices have been used 'for real' in Chapter 9.

Having discussed some of the general issues revealed by the study, we now move on to discuss how the thematic analysis was combined from *both* sets of interviews to revise the initial design space we presented in Chapter 5.

6.4 Revised Design Space

The themes we have found in our exploration of the hand-holding devices were divided between emotional and practical themes (see Section 6.1.3). The second set of interviews revealed a different set of emotional concerns. We now need to discuss how these design concerns relate to Social Presence and emotional connectedness.

The sense of connection created between interlocutors when using our devices was highlighted by our participants as being important. This connection directly corresponds to our definition of Social Presence of increasing the salience of interlocutors; indeed it appears that our participants have identified Social Presence as being the means of sustaining their relationship through CMC even if they lack the technical vocabulary to describe it in such terms.

The concept of metaphor has no direct relation to our definition of Social Presence. However, it does appear to affect the sense of intimacy and closeness engendered by the device thus supporting LDDRs through the broader concept of emotional connectedness.

Personalisation refers to the use of traces which are unique to their partner (such as handwriting). Such a concept directly increases the salience of the other person and thus is likely to increase the sense of Social Presence engendered by personalised communication.

The sensory medium used within a message affects what can be said within that message. Although there is no connection between this concept and Social Presence, the nature of the message is likely to have a broader impact on feelings of emotional connectedness.

When considering whether a message is fleeting or realised, we have proposed that a fleeting message might be considered more precious due to it's rarity whereas a realised message would be valued for stimulating reflection and remembering. Neither of these aspects are related to Social Presence but they do relate to concerns surrounding emotional connectedness.

In terms of openness, a one-to-one connection highlights that a message can only come from the person's partner. In turn, this is likely to increase the salience of the person's partner in the act of communication and subsequently the feeling of Social Presence.

Based on our participants comments, we would argue that synchronous communication is better at highlighting the connection between interlocutors and thus increases the salience of the person's partner. This is likely to increase their sense of Social Presence.

As it is hard to conceive of a communication technology which is not reciprocal and thus it is meaningless to discuss how reciprocity and Social Presence interact. Of more interest is the concept of symmetry within the issue of reciprocity. The lack of symmetry within a communication system could decrease the connection experienced between partners given the inability to respond to a message in kind. This in turn would likely lead to a decrease in the sense of emotional connectedness experienced by the couple when using the communication technology.

The serendipitous act of happily discovering the a message may cause the receiver to reflect upon their relationship, highlighting the salience of the other person and increasing the sense of Social Presence. Even without this act of reflection, the discovery of the message is likely to increase the sense of emotional connectedness between the couple.

Having discussed how the identified themes relate to Social Presence, we now reflect on how these themes can inform the design space we proposed in Chapter 5.

The practical themes from the hand-holding interviews had more to do with how participants viewed their management of communication than on how the communication would affect their relationship. We found this to be a significant factor in our investigation of Social Presence (see Chapter 4). The concerns which were raised by our participants spoke to two things – the first was ***Channel Abuse*** whereby an unexpected individual could use the device. Participants generally felt that using an addition channel would overcome these difficulties. Additionally, the factors of ***Biomechanical Compatability*** and ***Mechanical Noise*** are artefacts of the methods used to create the prototypes rather than of the design facets. That is not to diminish the value or impact of these factors but to state that they are beyond the scope of consideration for our design space.

In terms of the Emotional themes we have discussed, the first to discuss is that of ***behaviour***. The second interview study indicated that our participants were content with the idea of mimicking co-located behaviours in communication technologies, the reason being that such mimicry could imbue their communication with a greater sense of personal connection.

One of the concerns that people had was that we were trying to replace their behaviours by encouraging them to use these devices. This wasn't our intention; we have been trying to complement what the behaviours already exhibit. Once it became clear to our participants that that was our aim, they saw the devices as creating an additional personal connection between them and their partner rather than devices aimed at replacing their existent behaviour.

The concept of a ***personal connection*** was raised frequently by all of our participants; it seemed to be the way that people assessed the devices. It is straightforward to derive an argument that personal connection and Social Presence are interlinked. We examine this in greater depth in the case studies using these devices (see Chapters 7 through 10).

In Section 5.4 we proposed our initial design space, based on an analysis of the relevant literature and the creation of our communication devices. Many of these design ideas were supported by our analysis of our participants responses.

Personalisation was discussed within both of the interview sessions. Regarded as a positive thing, the breakdown on personalisation by device and message highlights some of the different ways which personalisation can be achieved. Our data reaffirms the inclusion of personalisation within the design space.

Our devices were expressly designed to explore different ***behavioural metaphors***. It is therefore unsurprising that this factor featured heavily in both of the interview studies. In the hand-holding interviews, we demonstrated how a different metaphor can result in the design of very different devices and how those different devices can generate very different responses from users. Similarly, presenting hotHugs as being usable in a number of different ways generated very different responses. This all supports the idea that metaphor is a significant factor for design and should be included in the design space. However, the sensation of weirdness reported by some participants implies a clear requirement for abstraction.

Openness was a theme which was included in the design space based on the development of our devices. Widely discussed by our participants in the second set of interviews, there appears to be a trade-off between the openness of the system and both the type of message that is being send and the connection which is trying to be formed. There is a connection between the level of intimacy of an act and who you would perform that act with: although sending a note does not necessarily have to be intimate, it is difficult to conceive on a non-intimate hug. Our data does seem to indicate that forcing a connection to be 1-to-1 does imbue it with special meaning in certain circumstances. However doing so in other circumstances could cause frustration (in doodleMessenger for example) because the messages are not reserved for intimate communication.

Few participants spoke of the ***sensory media*** that was used in the various devices; those comments that were received occurred mainly in the second set of interviews. This lack of discussion, we argue, could indicate that the media that were used were considered appropriate for trying to connect long-distance partners. During both of our interviews, tangibility was raised as an issue. In the first interview set, this focussed on the use of touch as an interaction technique, something which was received positively. In the second set of interviews, the physical note produced by the MSD was highlighted as being particularly special.

We now go on to discuss those factors from the interviews which were not in the initial design space and which could be included in the revised design space. Table C.1 in Appendix C shows how the features of the revised design space are realised within each of the prototype devices.

6.4.1 Synchrony

Although synchrony wasn't identified as a theme in of itself, it did form part of the discussion around personal connection in our first interview session. Although people could recognise the convenience of having an asynchronous link, the connection that a synchronous link created was considered more personal. Four of the devices were of a synchronous nature (hotHugs, hotHands, hotMitts and YourGloves) and these gave us the ability to explore the concept of a tangible voice-mail. Such an idea was disliked as it weakened the perceived connection between the interlocutors.

Synchrony has a direct relation to the concept of serendipity and availability. In terms of serendipity, although synchronous communication can occur in a serendipitous manner (for

example, an unplanned phone call), it is easier to conceive of asynchronous systems which create a stronger sense of the 'happy discovery' of a message (such as receiving a letter). Availability describes the ability to use a communication system at a time and location of the user's choosing. If the designer wants to develop a synchronous system which remains available, it necessitates the development of a mobile system. It is harder to conceive of the value of a synchronous system which has limited availability.

Although not directly discussed in our analysis of the literature, synchrony is a well established concept in computer mediated communication and was discussed by our participants in terms of strengthening their relationships. As such we are now proposing adding it to the design space.

6.4.2 Reciprocity

Reciprocity refers to whether the receiver of a message can send a return a message back to the sender of the original message. An additional layer to this design facet is whether the reciprocated message is in the same form as the original message; a symmetrical exchange of messages.

Synchronous media are inherently reciprocal and symmetric – phone calls for example – while asynchronous media, such as letters and emails, are also reciprocal but may be asymmetric. For example, someone might respond to an email with a letter.

Thinking of mainstream media which are not reciprocal is hard. It is possible to respond to any communication message but it may not be possible to respond in a symmetric form. Poking someone on Facebook is one such example – although possible to poke back, the medium does not encourage it. Sending someone flowers is perhaps a more appropriate example. Examples do exist within the research community; for example, the ComSlippers [Chen et al., 2006] are augmented slippers owned by one member of the partner which are activated by the other partner.

From our own devices, the belt version of the hotHugs system is very much asymmetric in it's reciprocity, as is sleepyWhispers. Questions of reciprocity were not raised for sleepyWhispers, possibly because there is a clear split between the recording and listening of messages; the connection is not a synchronous one. Conversely, many of our participants commented on the non-reciprocal nature of hotHugs, that the generation of the signal didn't offer them any sense of connection to either the communicative act, nor their partner. This was one of the reasons that the pillow version of the system was generally preferred – squeezing a pillow was much closer to the act of hugging someone that stroking a soft-toy is.

Some designs will make asymmetric reciprocity difficult because there may not be an obvious or easy way to do back to a sender what they have done to/for you. Other designs might foster reciprocation by inviting someone to respond in kind. This does not imply that one is inherently better than the other but it is worth considering how the communication system will create the most personal connection possible. For that reason, we have added reciprocity to our design space.

6.4.3 Serendipity and Anticipation

Although surprise and anticipation had been thought of in the conception of the MSD, it was not included in the design space as the other devices did not include any sense of serendipity and the literature was relatively sparse. It was an issue which our participants highlighted and as such is worth considering further.

Anticipation can have a powerful effect on the value of an event, when it happens. Anticipation is the business of thinking about the actor involved, their motives, the extent to which they are believed to care about the person they act upon. Thus systems which intend to build up anticipation could positively benefit relationships. Anticipation generally occurs in the time leading up to an event or activity (such as anticipating a Skype call planned for the evening).

Serendipity is in some ways the antithesis of anticipation. It concerns the 'happy accident' of discovering a message. Examples could range anywhere from an unexpected phone call to finding a letter on your doormat.

Although difficult, serendipity can be designed for. Simple examples include inserting a random time delay for message delivery or only delivering once a day (like the postal system). This makes the arrival of messages more unpredictable increasing the opportunity for serendipitous discoveries. Such design concerns were implemented in the Magic Sock Drawer. Similar concerns were built into sleepyWhispers where a listener never knows whether they have a message (or what form the message might take) until they listen to them. In both cases, the pleasure in receiving an unexpected messages is experienced by the receiver of the message. However, we should not disregard the author of the message. Our participants discussed the pleasure in anticipating the arrival of a particularly valued message and thinking about the pleasure experienced by their partner. Such concerns relate to the concept of gift giving, as discussed in Section 2.7.3, whereby a sense of we-ness is engendered in both partners by the process of exchanging gifts.

The advantage of having serendipity within the system is simply that; one of randomness. It does however come at a cost. If the serendipitous nature of the system is not understood, message senders may anticipate a response in a timely manner. If a reply is not forthcoming, emotional strain can be placed on the relationship. Care should be taken to design for serendipity such that it minimizes the risk of damaging the relationship.

We are proposing the addition of Anticipation and Serendipity to our design space. They co-exist in our framework because they both leverage ideas about happy discovery, and feelings in the moment.

6.4.4 Availability

The ability to use a particular device at a time and location of the user's choosing is encapsulated by the concept of availability. This was raised as a significant issue in the second set of interviews, particularly with regards to doodleMessenger and the Magic Sock Drawer. The comments centred around wanting to create notes at times of the participant's choosing rather than having to wait until they got home. This was due to both seeing things which inspired them in addition to best utilising their time; that is at moments convenient to them. This has overtones of the communication management desire from our analysis of existing behaviour (see

Chapter 4). Routine behaviours are a form of intimately shared experiences; each couple have a unique set of routine behaviours which work for them. Restricting the availability of devices has an impact on the formation of such routines around certain communication devices.

There is a relationship between a mobile device and availability; a mobile device is available to use all of the time. Similarly, a web-based device is a lot more accessible than any device which requires custom hardware (as all of our devices, bar doodleMessenger, do). Availability can also be artificially restricted; for example, you could limit the number of messages which could be sent or the times at which messages could be sent. In some sense, considerations of openness can be thought of as a restriction on the availability of who messages can be sent to.

Although our participants wanted the devices to be more available, a case could be constructed that limiting availability could be advantageous. If messages are limited, their value could increase; similarly to the way that 1-to-1 messages are more valued as they only come from one individual, perhaps limiting the availability of sending messages has a similar impact on value. For that reason, we have included availability into the design framework.

6.4.5 Evocativeness

Evocativeness is "the quality of being evocative; a tendency to evoke memories, feelings" [Oxford University Press, Accessed May 2012]. Our first set of interviews indicated that memories had a significant impact on our participant's perceptions of the devices for two reasons.

The first was the role that cultural memories played in the acceptance of the prototypes. People found comparisons with the hand imprints in Hollywood and finger-painting as children a way to understand the design facets. This could be useful when presenting designs which are extremely novel or innovative in nature. However, these cultural memories are already realised within the design space through the inclusion of metaphor.

The second role was more significant. In a number of cases, the devices caused people to remember a significant moment within their relationship and a subsequent visceral attachment to the device. These personal memories made using the device much more pleasant. It is also anticipated that devices based on such memories would create stronger connections between the participants. Although not mentioned in our second set of interviews; the flexibility of the note-sharing systems (doodleMessenger and MSD) could allow people to create notes based on memories significant to their relationship or any other personal idioms they have.

The difficulty is that it is impossible to tell what stimuli will cause memories to be relived – a smell, a sight, a half-forgotten touch. Some attempts have been made to harness memories within technologies, these have tended to focus on self-reminiscing, particularly for therapeutic reasons (e.g. [Crete-Nishihata et al., 2012, Cosley et al., 2012, Petrelli et al., 2008, Cosley et al., 2009]). We recognise the importance of memories in relationships but the difficulties around knowing how to stimulate particular memories mean that we are not including evocativeness in the design space at the stage. However, hotMitts and hotHands are deliberately linked to a salient shared experience. This is under the designer's control. Data from the case studies may result in further changes to the design space being made.

6.5 Design Space Verification

In Section 5.4 we discussed how the ability to place devices within our conceptual design space demonstrates that it is, to some degree, fit for purpose. We have previously described all of the research devices we discussed within Chapter 2 in terms of our initial design space (see Appendix A). Appendix D may be consulted for a full analysis of these research devices in terms of the remaining aspects of our design space. In Appendix C we discuss how the devices we developed within this thesis relate to our design space. In Table 6.8 we place many of the commercial communication devices used by people in LDDRs (see Chapter 4) within our design space. This ability to place three distinct set of communication devices within our design space stands as verification that the design space successfully maps part of the space describing a set of communication devices which could support LDDRs. Our discussion of our participants responses to these design facets as realised in our devices goes some way towards describing the design rules which, combined with our conceptual design space, would create a generative design space.

Design Facet	**Face to Face**	**IM**	**SMS**	**Telephone**	**Skype**	**Email**
Metaphor	Itself	Sharing notes	Sharing notes	Face-to-face talking	Face-to-face talking	Sharing notes
Personalisation	Through voice and seeing the other person	None	None	Through voice	Through voice and seeing the other person	None
Effort	–	–	–	–	–	–
Sense	All	Sight	Sight	Hearing	Hearing and sight	Sight
Fleeting/realised	Fleeting	Realised	Realised	Fleeting	Fleeting	Realised
Openness	Many-to-many	Many-to-many	Many-to-many	Many-to-many	Many-to-many	Many-to-many
Synchrony	Synchronous	Synchronous	Asynchronous	Synchronous	Synchronous	Asynchronous
Reciprocal	Reciprocal	Reciprocal	Reciprocal	Reciprocal	Reciprocal	Reciprocal
Serendipity	Serendipitous or planned	Planned	Serendipitous	Planned	Planned	Serendipitous
Availability	While people are together	Fixed/Mobile depending on use	Mobile	Mobile/Fixed depending on type	Fixed/Mobile depending on type	Fixed/Mobile depending on type

Table 6.8: Commercial devices design space features

6.6 Summary

This Chapter aimed to analyse some of the important design facets which could assist in the design of communication technologies for long distance dating relationships. Our interview studies has partially addressed our second research questions, to whit:

> **RQ2: What design facets are significant when considering the design of communication technologies for long distance dating relationships?**

To summarise our findings, this study has found:

- Empirically we have collected a new set of data to investigate the factors which have an impact on the design of communication technologies for LDDRs
- We are in a position to present a revised design space which has both theoretical and practical implications. The revised space includes the following ten properties:
    1. Metaphor of use
    2. Personalisation
    3. Effort
    4. Sensory Medium
    5. Fleeting versus Realised Output
    6. Openness of the System
    7. Synchrony
    8. Reciprocity
    9. Serendipity and anticipation
    10. Availability
- Methodologically we have extended previous work by examining participant's perceptions of our devices, an improvement on the lack of evaluation observed in Section 2.8

In this study our aim was not to collect information on how participants used our devices but to use the devices as embodied artefacts to explore design themes in LDDRs. One of the major limitations of these interview studies is that participants' interaction with the devices happened individually, within a lab context. This limits our understanding to the level of conceptual design without developing an understanding of how the devices might be used within people's relationships. The next step is to investigate whether the devices had an impact on people's relationships more broadly through a series of long-term field studies about how these devices are used in practice.

Part II

Case Studies

Thus far in this thesis we have described our attempts to create a design space to help situate design decisions in the development of communication technologies for long distance dating relationships. We have also described the development of seven technologies which embody aspects of this design space. These devices are intended to support long distance dating relationships through generating high levels of Social Presence.

In the previous Chapter we presented an initial evaluation of these devices. This Part of the thesis takes the technologies which we have developed and deploys them across a number of long distance relationships. This is important as 'being-with' technology "does not merely make existing practices faster or more efficient but fundamentally change them" [Turner, 2008b, p. 453]. Such concerns cannot be addressed by design workshops but require devices to be deployed into people's everyday lives.

Five in-depth case studies were carried out, one for each of the developed technologies (excepting two of the hand-holding devices). Case studies do not provide between-participant data which allows us to make claims about the population at large. Instead, our case studies provide us with an in-depth understanding of how the technologies might work within people's relationships. The five case studies we are about to discuss provide an illustrative example of some of the concerns that couples in LDDRs might experience whilst using devices based on the mimicry of intimate co-located behaviours.

We are not attempting to analyse the devices to assess the prototype devices' interfaces nor their usability. Others have argued as to why this type of evaluation limits innovation:

> "if done to test radical innovations, the many interface issues that would likely arise from an immature technology can quash what could have seem an inspired vision... usability evaluation, if done prematurely, not only adds little value, but can quash what could have been promising design idea" [Greenberg and Buxton, 2008]

The design of the devices is not the only factor which will impact on whether the devices would be successful or not, as demonstrated by the picturephone [Noll, 1992]. Having said that, our primary concern is with the design of the communication technology rather than the social and cultural changes which surround their take-up.

Instead, we are interested in our participants; their experience of the facets within the design space, as realised through the devices, in their actual communication routine. Additionally we are interested in whether the devices are associated with high levels of Social Presence. These two concerns are based on our second and third research questions:

> **RQ2: What design facets are significant when considering the design of communication technologies for long distance dating relationships?**

> **RQ3: Do novel designs for devices based on the design facets from RQ2 engender positive feelings of emotional connectedness?**

These research questions lead to three specific questions which are explored through the case studies, namely: (1) What was the couple's normal communication routine? (2) How (if at all) did the devices have an impact on that routine? and (3) What did our participants think about

particular aspects of the design of the devices? The first of these questions aims to develop a better understanding of how the device is situated within the couple's communication routine and how the design facets embodied within the device make sense in their everyday lives. The second question attempts to establish whether the devices had value within the relationship in terms of the amount it is used or the emotional impact made by using the device. The third and final question focuses on whether particular design facets were valued or disliked by our participants and whether alternative design facets are of more significance to them.

Having discussed why we are undertaking these case studies, we now move on to examine our pilot study involving a field study of the Magic Sock Drawer.

Chapter 7

Magic Sock Drawer Pilot

7.1 Introduction

This Chapter discusses a pilot case study based around the Magic Sock Drawer system. This case study had two main purposes; the first was to establish what value, if any, the MSD had to a long distance couple. Secondly, as a pilot, the study was intended to establish an appropriate method for conducting further studies intended to establish how a particular LDDR technology might relate to routine intimacy and shared experiences.

The study participants (pJ and pA) were a male/female couple, living within the same city but in separate houses. These houses are around 40 minutes driving time from one another. Both were living in their respective family homes and felt unable to be together as often or in the way that they wanted to be. Both aged 23 at the time of the study, the couple had known one another for seven years and had been partners for four years. Of those four years, the first three had been spent as a distance couple, pJ living in Coventry and pA living in Bath. For the year preceding this case study, the couple had lived together in the same house in Bath. This change (from living together to being apart) could help explain why the couple considered themselves to be a 'distance' couple despite living within the same city.

7.2 Methodology

The MSD system was installed within our participants homes for 6 weeks during this pilot study. Each of the three interfaces (drawing, typed and combined) was used for two weeks in succession. Participants were told that they could use the system however they liked. They were informed that copies of all notes were being stored for analysis but would be treated in confidence.

The couple were asked to keep a daily diary throughout the study period. The diary was completed every day, generally in the evening. Each entry consisted of the Semantic Differentials measure of Social Presence [Short et al., 1976]. Additionally participants were asked to complete a free-form entry. Participants were prompted with the following talking-points:

- What notes have you sent/received?

- How did the notes make you feel?
- How happy are you with your relationship?
- Whether you think using the MSD is changing your relationship?

In addition to the standard diary page, a separate entry was made at the beginning and end of each two-week stage of the study (i.e. before and after using each of the three interfaces). These entries consisted of a measure of relationship satisfaction, the Relationship Assessment Scale [Hendrick, 1988], and a measure of Closeness, the Inclusion of Other in Self Scale [Aron et al., 1992], as discussed in Chapter 4.

Example diary pages can be seen in Figures 7.1 and 7.2.

In addition to the data collected by the diaries, we completed an interview with the participants together. The interview was meant to discuss the couple's relationship and how they used the MSD system. Table 7.1 shows the questions which guided this semi-structured interview.

Both the diaries and interviews were analysed using the thematic analysis method we have previously discussed (see Chapter 3). The purpose of this analysis is to ensure that relevant themes are revealed through the procedure being piloted. It is not possible to debug the study methodology unless meaningful results can be gathered and analyses performed.

Having discussed the methodology we used within this case study, we now move on to discuss what the data we collected can tell us about the MSD and it's impact on the couple's relationship and their communication habits.

7.3 Results and Analysis

In total, 28 notes were sent over the 6 weeks of the study. 20 of those were sent using the drawing interface (first phase), 6 used the typing interface (second phase) and 2 were sent using the combined interface, using the drawing aspect alone (third phase).

At first glance, this suggests a very strong novelty effect, that the system was used a lot during the initial period and that although there was a minimal level of interest beyond that point, participation dramatically dropped off.

However, we do not believe this was the case. The participants faced some major lifestyle changes during the experiment including pA being made redundant and moving house. This dramatically changed the couple's communication behaviour. As the diaries and interview made clear, the system was most used when the participants had not seen one another that day - something which was far more common before these life changes:

"certainly recently we've started seeing one another a lot more so we weren't using the [MSD] system as much" [pJ, interview]

A weaker interpretation would be that the drawing interface was dramatically preferred over both the text and combined interfaces. The interviews made clear that drawing was preferred over text and it is possible that when the interface switched over to text only, participation dropped off so dramatically that it never recovered. As pA stated during the interview, "I

Please remember that each diary entry is about your experiences with the magic sock drawer. This could include (but isn't limited to) what notes you've sent/received and why, how the notes made you feel, how happy you feel about your relationship and whether you think using the magic sock drawer is changing your relationship. Please fill in the diary regardless of whether you've used the magic sock drawer that day.

8th October

How would you describe your use of the magic sock drawer today?

	3	**2**	**1**	**0**	**1**	**2**	**3**	
Impersonal								Personal
Cold								Warm
Ugly								Beautiful
Small								Large
Insensitive								Sensitive
Colourless								Colourful
Unsociable								Sociable
Closed								Open
Passive								Active

Figure 7.1: An example Daily Diary Page

8th October 2010

Please answer how satisfied you are with your relationship on the following scale:

	1 Low Satisfaction	2	3	4	5 High Satisfaction
How well does you partner meet your needs?					
In general, how satisfied are you with your relationship?					
How good is your relationship compared to most?					
How often do you wish you hadn't gotten into this relationship?					
To what extent has your relationship met your original expectations?					
How much do you love your partner?					
How many problems are there in your relationship?					

Please circle how close you currently feel to your partner?

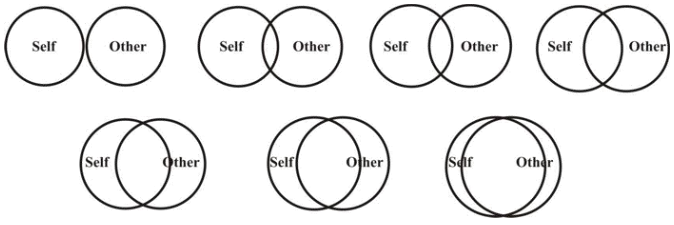


Figure 7.2: An example Relational Satisfaction Diary Page

General Questions • What were your general thoughts and feelings about the Magic Sock Drawer system?
Communication Ecology • Did sending notes replace communicating by other means or did you send extra messages? • What kinds of messages did you send through the system? • What sort of routine did you develop around sending and receiving the notes?
Use of the MSD • What did you think about the personalisation aspect of the system? • Which of the interfaces did you like? Was there something you would have liked to have changed? • Would you have preferred to have been able to send a note from any computer rather than use the fixed tablet? • Where did you put the printers? Why? • What were your thoughts about no one else being able to use the system? Would you have liked to have sent notes to anyone else? Do you think that would have changed your perception of the notes? • What did you do with the notes once you'd received and read the notes? • Did you show any of the notes to anyone else or just keep them completely private?
Feelings around the MSD • How did you feel when you received a note? • In a broader sense, do you think having the system had an impact on your relationship at all? • Do you think you're going to miss using the MSD system?
Other • You knew that I was recording all the notes for study reasons... do you think you would have sent different notes if no record was being kept? • Do you have any other comments?

Table 7.1: The Interview Questions for the MSD Interview

enjoyed using it mostly when I could draw pictures". This however seems appears to be a less likely explanation than the lifestyle changes that the couple were experiencing.

An analysis of the notes, suggests four types of content – pings, personal idioms/humour, information exchange and romantic notes. Pings are notes which hold no specific content but are designed to create a connection between the partners. Although these notes are not associated with any specific design facets within the design space, the focus of pings on forging a connection between the couple likely makes them meaningful in terms of Social Presence. Personal idioms are notes which use information which is relationally meaningful only within that specific relationship. We suppose that these notes are extremely relationally meaningful, particularly given the strength of personalisation embedded within this type of note. Romantic notes are those which focus explicitly on connecting the couple through intimate expressions. These notes are likely to be extremely relationally meaningful. Notes which focus on the exchange of information hold no specific relational meaning. Table 7.2 shows how many notes from each interface contained each content type. Figure 7.3 shows an example of each content type from each appropriate interface.

Interface	**Ping**	**Personal Idiom/ Humour**	**Information/ Question**	**Romantic**
Drawn	1	9	4	2
Handwritten	5	0	0	1
Typed	6	0	0	0

Table 7.2: The breakdown of MSD notes by interface and topic

The content of the notes suggests that the MSD was relationally meaningful; a large proportion of the notes are of a humorous or romantic nature (intended to foster feelings of Closeness), and the majority of the remaining notes are informative or pings (intended to help them stay connected with their partner).

Considering the quantitative part of the diaries, neither the Semantic Differentials, the IoS nor the Relationship Assessment Scale show a significant difference across the different phases of the study.

We now move on to discuss the results of the thematic analysis from both the interview and the diary entries.

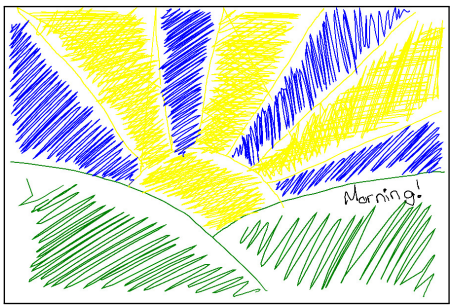
7.3.1 Context of Use

In terms of use, the participants had a clear routine for sending notes. The MSD did not replace any other forms of communication:

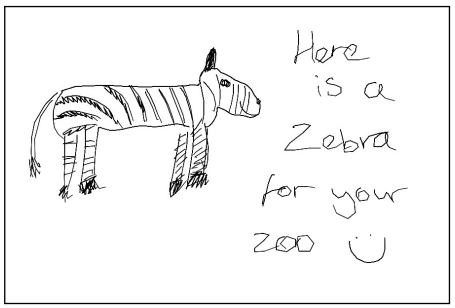
"I think it was extra [to other communication]" [pA, interview]

and the notes were intended to help the couple remain connected throughout the periods of time which they could not be together, typically mornings and evenings.

"I kind of got into a routine of using it morning or as an evening thing as I tended to see you during the day" [pJ, interview]

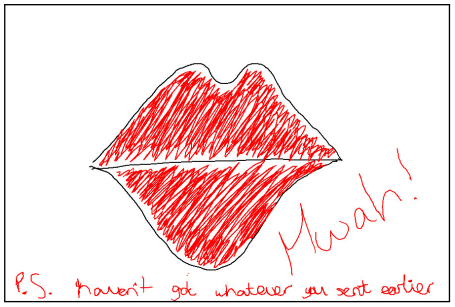


(a) A drawn ping note

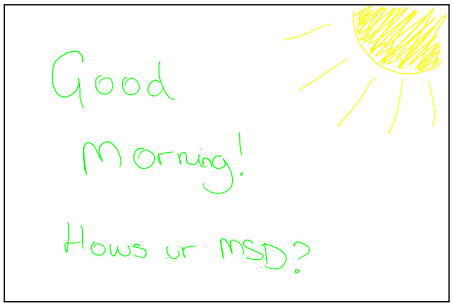


(b) A drawn personal idiom note

(c) A drawn question note

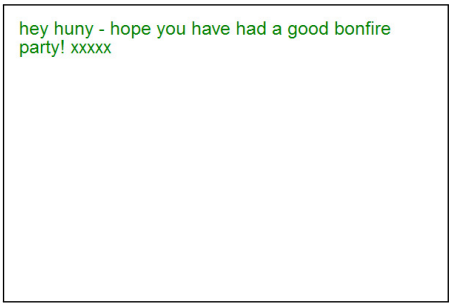


(d) A drawn romantic note



(e) A handwritten ping note

(f) A handwritten romantic note



(g) A typed ping note

Figure 7.3: Example notes sent through the MSD

Our participants view of the system corresponded with the type of messages that they sent, reserving the notes to exchange fun messages rather than 'actual' (or information exchanging) messages:

"I wouldn't use it if I was trying to get hold of someone... so it was more just kind of fun than for actual communication..." [pA, interview]

The MSD was, by design, a 1-to-1 communication system. The theory is that if participants know that they can only send notes to one another, the value of those notes increases. pA explicitly said that she wouldn't have wanted to have used the system with anyone else. pJ was less certain about the 1-to-1 nature of the system but saw the value that it embedded into the notes:

"Knowing pA was the only one that could send me things was more of a personal thing... if you open it up to everyone you might then get a little bit... desensitised to the receiving of the messages" [pJ, interview]

For ethical reasons, we had decided to tell our participants that copies of the notes were being recorded. This was done as the notes were likely to be very personal in nature and recording them was potentially a violation of trust. However, the monitoring of the notes sent did have an impact on what notes were sent through the system with the suggestion that some more explicit content may have been sent.

"I had to be a bit more careful, because of you family members... I would have had to say 'you have to stand in your room by your sock drawer until you receive this' and then it wouldn't have been a surprise" [pJ, interview]

It is not immediately clear how this issue could be resolved without losing the information about the notes.

7.3.2 Location

We have previously discussed how location was an element of the MSD intended to increase the intimacy of the notes (see Section 5.2.1). Although location was highlighted by our participants, their focus was less on intimacy and more on privacy. Living in shared houses, they were more concerned about their families seeing such intimate message than having the printer in a particular location.

"I mean it's different in our houses, as we're in family houses, not our own homes. If we were in our own homes it could have been anywhere and it still would have been our own personal messages... whereas as we were in shared houses, someone else might have got the messages" [pJ, interview]

"I think I wouldn't display them as I know full well my family members come in my room with no concern so..." [pA, interview]

Going beyond the original design ideas built into the MSD, our study participants reiterated what our interview participants had argued with regards to the availability of using the device. The MSD is static, participants can only generate and receive locations from a fixed location within the home. pA in particular would have preferred some flexibility in the generation of notes, questioning whether notes could be made upon a mobile phone. This was of particular

significance given the amount of time that pA spent travelling for work; this meant that for large sections of time there was no way for her to create or receive the notes. This corresponds with our findings from the second interview study (see Section 6.2) where participants discussed merging the tangible aspects of the MSD with mobile phones to make the technology more accessible.

"if there was a way of doing it from a mobile so you could do it whilst you were out and about" [pA, interview]

7.3.3 Personalisation

In terms of the different interfaces, the free-form drawing interface was preferred. This appears to be for two main reasons; the first being personalisation, the drawn notes are simply considered as being more personal. Secondly, the drawing aspect is unique; as we've previously mentioned, participants didn't see a use in exchanging textual messages through the MSD when they could send a SMS message.

"I much prefer being able to draw pictures, it makes it completely different to just texting someone. It's much more personal" [pA, diary]

"either something nice and sentimental and emotional or humorous" [pJ, interview]

"I was looking forward to getting back to drawing again" [pJ, diary]

7.3.4 Tangibility

Another design decision was to create tangible notes using the printer. Both participants kept all of their notes.

"just kept them in a pile next to the printer" [pA, interview]

"mine are all on my chest of drawers... I didn't throw any away" [pJ, interview]

The fact that participants kept their physical notes, in a manner similarly to letters, indicates that the permanence associated with this form of tangibility was significant. Participants didn't stick any notes up but both stated that this was due to confusion over whether they were allowed to keep the notes after the end of the study.

The retention (and possible display) of the notes demonstrates an aspect of the value of tangibility as a design concept.

7.3.5 Effort

The effort involved in using the MSD did have some negative consequences. As one of the participants wrote in their diary, on several days they did not have the time to use the system. This implies that if participants are busy, the system will not get used as it requires too much input from the user. pA made it clear several times in her diary, "I did not have time to use the sock drawer".

However, when effort was invested into exchanged notes, it was very much appreciated:

"It was nice that... someone's put the effort in to making the message" [pA, interview]

"the feeling that someone's been thinking about you enough to kind of take some time out of their day to do it was good, it was nice" [pJ, interview]

"pictures were completely different, they were worth doing whereas the text ones I may as well just use my phone" [pA, interview]

As these quotes make clear, the investment of effort into the MSD notes was one of the factors of distinguishing the technology from other forms of communication such as SMS messages. Spending time thinking about your partner and creating a note which is uniquely aimed at them was appreciated by the receiver.

7.3.6 Impact

In terms of the couple's relationship, it is hard to assess the wider impact that the MSD had. The general feeling was that the system didn't have an impact on any "massive, deep level" (pA, interview) but that in the short term they had a positive impact, the notes being described as being:

"emotionally engaged, but not at a superficial but at a contact level..." [pJ, interview]

No negative messages were sent through the MSD, highlighting that the system was reserved for positive relationally significant messages.

"even sending something negative, there were no negative messages sent, even something as basic as 'I had a bad day"' [pJ, interview]

Finally, the absence of new notes caused a level of sadness; although this could be positioned as a negative consequence of using the system, it also highlights the positive emotional impact of receiving a note.

"I was sad when I didn't get messages" [pJ, interview]

7.4 Discussion and Conclusion

Being a pilot study, there are three main areas to discuss within this section. We first discuss how the preliminary data we have collected on using the MSD informs our understanding of how it might help support LDDRs. We then move on to discuss a number of methodological concerns which the pilot study raises before concluding with a description of two practical concerns of the study that need to be addressed.

7.4.1 Preliminary lessons from MSD as support for LDDRs

Overall the MSD appeared to have a positive affect on our participants relationship. In particular, the personalisation, effort, 1-to-1 communication and tangibility elements of the MSD design were associated with notes which created a positive emotional experience.

The second purpose of this study was to determine how best to perform such case studies; to examine the methodology and determine how to adjust it for use in other studies. As such, we

now need to discuss both successes and shortcomings in the methodology used for this study – the following Chapter will build upon these findings and establish a more robust methodology to be used across the next five case studies.

The first point to make is that there is some doubt as to whether we should consider pA and pJ as being a long-distance couple. Although that is how they conceived of themselves, some people may question whether living in the same city (at 40 minutes distance) constitutes a distance relationship. The position that we take is the same as when we previously discussed relational distance (see Section 2.3) – long distance is best described as a self-defined concept. What one couple thinks of as being long distance, another couple may not. It is not our position to tell a couple that we do not consider them to be long-distance when that is how they think of themselves.

7.4.2 Methodological considerations

In methodological terms, the combined use of diaries and interviews was largely successful. The difference in temporality led to different types of data being recorded; the diaries capturing in-the-moment sensations and feelings whilst the interviews captured broader information about how participants considered the system as a whole.

The study does however identify a number of flaws with our proposed methodology. Only recording data during the installation of the MSD means that we have no method of comparing it to previous communication habits; nor do we have any information of how (or if) such habits changed after the installation was finished. Recording some form or pre- and post- data would adjust for this.

We have discussed at length how Social Presence is conceptualised as an 'in-the-moment' sensation, something which occurs during a single act of communication (see Section 2.4). The current system of data collection does not collect data in this form. Although the daily diary gives information which is relevant about the couple's relationship as a whole, it doesn't inform us about specific acts of communication. Similarly, no data is collected which allows us to compare between communication technologies. These flaws will be addressed in the next Chapter where we describe the methodology for the full set of case studies.

In addition to these methodological flaws, there are two other considerations which our pilot case study has highlighted.

7.4.3 Practical Concerns

The first is the need to provide a large amount of technical support and monitoring. The technologies we have developed are prototypes and are unlikely to work perfectly in the wild. This pilot study has shown how such trials are reliably unreliable – things are highly likely to go wrong at some point and there needs to be a level of support to ensure that the technology starts working again as soon as possible.

The second is the need to discuss the level of disclosure our participants are happy with. During this pilot, having informed our participants, we kept a record of all notes sent through the system. As we have already discussed, this did limit the notes that the couples sent. In

some situations, it may be preferable to not record any messages during the study and simply discuss the messages with participants. This issues needs discussion on a case-by-case basis with each case study's participants.

Chapter 8

Case Study Methodology

In the previous Chapter we piloted both the Magic Sock Drawer and the methodology required to run these case studies. In this Chapter we outline the methodology which was used in the following five case studies, indicating where appropriate how the methodology has been developed from the MSD pilot.

The pilot study showed that diaries and interviews were an appropriate way of gathering data and that the two techniques complemented one another, revealing different aspects of the same phenomenon. As such, there was no compelling need to change the method of collecting data. However, the lack of data about the pre- and post- use of devices is a serious limitation because there is no means to compare use of the device against previous communication habits. Furthermore, there is no way to see if these habits changed after stopping using an LDDR device. As such, data collection for all subsequent case studies was conducted over a 2-month period. The first two weeks of data collection will be termed 'pre-use' and will include completing the diaries alongside an initial interview. 'During' covers the four weeks of our participants using the device and includes completing the diaries and an interview at the end of the period. The 'post-use' stage runs for two weeks after using the devices and will consist of completing the diaries.

As Bolger et al. [2003] makes clear, "three broad types of research goals can be achieved using diary designs: (a) obtaining reliable person-level information; (b) obtaining estimates of within-person change over time, as well as individual differences in such change; and (c) conducting a causal analysis of within-person changes and individual differences in these changes". Our research interests correspond to these questions, validating the use of diaries within this context.

Couples will be asked to complete two diaries throughout the study period. The first diary was termed the 'Daily Diary' and was intended to be completed once a day. In addition to an Inclusion of Other in Self Closeness measure, participants were asked to write about their relationship with a number of guiding prompts based on the experience of the pilot study:

> 'How do you feel about your partner/relationship today? If you communicated with your partner today, how did it make you feel? Did it last all day? Did you use the [devices] today? Why? How did it compare to how you normally communicate with your partner?'

This prompt was intended to investigate two main themes. The first was to get a general sense of the person's relationship and how they felt towards their partner. The second theme was focussed on developing a sense of the couple's communication habits on a daily level, abstracted away from the details of specific acts of communication. Both themes combine well with our conceptualisation of Closeness as a relational concept which operates over a longer time compared to Social Presence.

This diary gives no information regarding specific acts of communication which is essential for considering Social Presence. As such, a second diary was introduced, the 'Contact Diary'. This diary will be completed every time the couple communicate. Each entry consists of the date, the communication media used to communicate and the Semantic Differentials measure of Social Presence. Additionally participants will be asked to answer three free text questions:

- 'Briefly say what you talked/wrote about'
- 'How did it make you feel and why?'
- 'Did this exchange make you feel appreciated? Why'

These three questions were designed to gather information on different aspects of communication acts (conversation topic, emotions and appreciation). These three topics were selected for further investigation based on our understanding of relational communication (see Chapter 2) as potential factors which could impact feelings of Social Presence.

We did not include the relational satisfaction measure used in the pilot study as it was not found to produce useful data as discussed in Chapter 7.

The diaries, through their measures of Social Presence, provide us with the data to partially answer our third research question, namely:

> **RQ3: Do novel designs for devices based on the design facets from RQ2 engender positive feelings of emotional connectedness?**

The Daily Diary also provides information regarding how the design facets built into the devices, helping answer our second research question:

> **RQ2: What design facets are significant when considering the design of communication technologies for long distance dating relationships?**

Example diary pages can be seen in Appendix E.2.

We acknowledge that there are drawbacks to repeatedly asking participants to complete diary entries, especially with regards to introspection. Wilson and Kraft [1993] ran a study with dating couples who had been together less than 6 months. Participants completed a questionnaire about 'all the reasons you can think of why your relationship with your dating partner is going the way it is' repeated once a week over 4 weeks. Control condition participants were asked about why they chose their college major. Participants also completed the Spanier Dyadic Adjustment Scale before and after completing the questionnaires. "After people analyzed the reasons for their relationship once, they changed their attitudes toward their relationship more

than the control condition did" [Wilson and Kraft, 1993, p. 415]. Repeated introspections into their relationship changed participant's feelings about their relationship. There is little we can do to limit participant's introspections – indeed, we are actively seeking a level of introspection to better understand how to design communication technologies to support them. To a certain extent, the interviews assist us in overcoming this introspection by taking a broader perspective on our participant's relationship.

In addition to the two diaries, we plan to complete two interviews with the participants. The first interview covers the formation of the participants relationship and how they think they normally communicate (and why) (see Table 8.1 for the questions). This produces a baseline of understanding which we can then compare the participants use of the device against.

Relationship Questions

- How long have you known each other?
- How long have you been partners?
- How did you meet?
- How long have you been a couple?
- Have you always been a distance couple?

Communication Routine Questions

- So could you please describe to me how you communicate with one another?
  - Prompt: What types of medium? Why did you use them?
- Could you please describe how that communication made you feel?
  - Prompt: how did it make you feel in terms of closeness?
- Now that you live apart, has your communication routine changed at all?
- Has this change in communication affected your relationship?
  - Prompt: closer, more distant?
- Now that you've moved away, describe how your communication makes you feel? Different than it did before?
- Can you think of an example when you really wanted to talk to each other but had to do so in a way which wasn't satisfactory/you didn't like?
- What would you like to change about the way you communicate?

Table 8.1: The Interview Questions for the First Interview

The second interview investigated how our participants used the devices within their relationship, what they thought about specific design qualities of the device and whether using the device had any impact on their relationship (see Table 8.2 for the questions). Certain questions, only relevant to particular devices, are presented within the relevant Chapter. The second interview focuses on gathering data necessary to answer the two two research questions the case

studies are intended to answer.

General Questions

- What were your general thoughts about [device]?
- Could you describe how you used [device]?
- How did you find using the system?
- How did you go about organising to use the [device]?

Communication Ecology

- How did [devices] fit in to how you normally communicate?
  - Did it replace existing technologies or messages or did you use it as-well-as?
- How did [devices] compare to how you normally communicate?
  - Prompts: Intimacy, closeness, social presence, connected?

Design Factor Questions

- These device specific questions remain embedded within the relevant Chapter

Feelings around [devices]

- How do you think using [the devices] has affected your relationship, if at all?
- What has been the impact of using [the devices] on how close you feel to one another?
- How did you feel when you were using [the devices]?
  - Prompts: Close, connected, intimate

Other

- Is there anything you would change or improve about [devices]? If so, what?
- Was there anything you would have liked to have done which the [devices] system didn't support?
- What are your thoughts about continuing to use [devices] (if possible)?
- Is there anything else you'd like to tell us or discuss about [devices]?

Table 8.2: The Main Interview Questions for the Second Interview

There are two main sources of qualitative data: the interviews and the free-text aspects of the Daily Diary. The interviews were analysed using the thematic analysis method we previously outlined in our Methodology Chapter (see Chapter 3).

Contact Diary Entries were analysed using a similar approach in order to develop the main

themes for each free-text question (Conversation Topic, Feeling and Appreciation). Each response was then coded into these themes to produce a nominal grouping that could be analysed quantitatively.

The quantitative data from IoS and Semantic Differentials were analysed using statistically sound methods (based on [Siegel, 1988]). In each case study the data does not follow the normal distribution meaning. It is not possible to run either a logistic or linear regression on the data. Graphing the data failed to show a linear relationship between the variables meaning that we can't perform a linear regression. Running logistic regressions on the data failed to show any meaningful relationships. We cannot report individual comparison of means tests (such as Kruskall-Wallis and Mann Whitney U) as all of our data comes from a single couple meaning that we do not have independent samples. We will primarily use descriptive statistics (means and standard deviations) as being indicative of characteristics to inform the qualitative analysis.

Having discussed the methodology we will undertake across all five case studies, we now move on to discuss the first case study: sleepyWhispers.

8.1 Ethics

Ethics becomes increasingly important within these case studies as our devices are now being used within a couple's relationship. We must thus be aware of the possibility that the devices could disrupt a couple's relationship in a damaging way.

The first step to prevent any disruption was to make it clear that participants were under no obligation whatsoever to use the devices we gave them. Additionally, in terms of completing the diaries, our participants were self-selecting in that if there was something they did not want us to know, they need not report it. Similarly, we had extensive conversations with our participants assuring them that we would not store the messages they exchanged through our systems. However, during the interviews we would request that participants talk us through some of the more meaningful notes.

We also ensured that the case studies complied with our other ethical obligations. Included in Appendix E.1 are the consent forms and ethical checklist used to ensure that the case studies were conducted in an appropriate fashion. Both forms were checked by the ethics officer within the Department.

To briefly run through the main concerns; the studies include no hidden procedures and no deception was involved. Participants were informed about the data being collected and it was made clear that it would be recorded anonymously and could not be traced back to the individual. It was also made clear that the data would not be passed to any third party (including their partner) and were not being collected for commercial reasons. However, participants were warned that the results of the study may be published in an anonymous form. Participants were interviewed separately where possible to ensure that their partner was not aware of the responses they gave.

It was made clear in the consent form that participation in this study did not involve physical or mental risks outside of those encountered in everyday life. The safety procedures taken to ensure the devices were safe were explained at length with the participants.

Most importantly, it was made clear that participants had the right to withdraw from the study at any time. Informed consent was taken from each participant.

Chapter 9

Case Studies

The purpose of this Chapter is to discuss five case studies we undertook to examine how our devices were used within existing LDDRs. The aim of each case study was to perform an in-depth investigation into how one particular couple used the device within their relationship. The case studies were motivated by three key questions: (1) What is the couple's current communication routine? (2) What impact did the device have on this routine? (3) What did our participants think about particular aspects of the design of the device? The first of these questions is intended to assist us in gaining a general understanding of the couple's relationship, what is important within it and how they currently communicate. This is important as it will help ground our understanding of how the devices were used within that context. The second question aims to address whether the device had any benefit within the relationship, measured in terms of their experience of emotional connectedness as expressed through their Social Presence scores and the interview data we collected. Finally, the third question relates to specifics of design; although we have investigated participant's views on the design decisions embodied within the devices, see Chapter 6, we wanted to investigate whether these views were reaffirmed by a couple who actually used the devices for a substantial period of time within their relationship. Additionally, new aspects of design could be revealed as being significant through the couple's use of the device within their relationship.

The design of each case study broadly adhered to the procedure laid out in our discussion of the Case Studies methodology (see Chapter 8). The study consisted of three phases: pre-using the device for two weeks, using the device for four weeks and post-using the device for two weeks. The exact dates for these phases for each device can be seen in Table 9.1.

Device	Pre-use start date	Using the device start date	Post-using the device start date
doodleMessenger	21/05/2012	09/06/2012	08/02/2012
MSD	23/01/2012	06/02/2012	05/03/2012
sleepyWhispers	12/03/2012	26/03/2012	23/04/2012
hotHugs	19/03/2012	16/04/2012	14/05/2012
hotMitts	21/03/2012	16/04/2012	14/05/2012

Table 9.1: Exact dates for each phase of each case study

Although we have presented three different hand-holding devices, our interview studies (see

Section 6.1) identified hotMitts as the device most suitable for most couples; as such it was selected as the prototype device to represent 'hand-holding' in this series of case studies.

This Chapter is organised in the following fashion. First we discuss our participants and some specifics about their relationship. We then present the particulars of the method used within each case study.

We then split the devices into one of three categories, reporting on the note-based systems (doodleMessenger and the MSD), then the sound-based systems (sleepyWhispers) and finally the tangible systems (hotHugs and hotMitts). After reporting the usage log of each device, and the ratings of Social Presence gathered throughout the study, we move on to discuss our thematic analysis, discussing both the impact the device had on our participants' relationship and their views on certain design decisions. Finally we conclude with a discussion of the case study as a whole. In Chapter 10 we collate the results of the various case studies together to discuss the commonalities and differences between them.

9.1 Participants

The doodleMessenger participants were a male-female couple, both aged 23 at the time of the study. Throughout this Chapter, the male participant will be referred to as 'pA' and the female as 'pB'. pA currently lives in Bath, UK and pB in West Drayton, UK, a distance of around 100 miles. The couple had known each other for around 9 months prior to the start of this study. They had been dating for 6 months prior to the start of this study. The couple have always lived at a distance. Each participant received a £50 payment for taking part in the case-study. The participants responded to an emailed advertisement, expressing interest in the trial as something that might contribute to their relationship. A financial incentive was included as an initial round of adverts had failed to recruit any willing participants.

pA owned his own android-powered phone and chose to use the doodleMessenger application on that. pB did not own her own android-based phone so she borrowed an android-based tablet for the full two months of the study. We will go on to discuss how this impacted the way our participants used doodleMessenger.

The MSD participants were a male-female couple, the male aged 26 and the female aged 23 at the time of the study. Throughout this Chapter, the male participant will be referred to as 'pR' and the female as 'pC'. The male of the couple had previously taken part in the interview studies where he was known as P1. pR currently lives in Bristol, UK and pT in Durham, UK, a distance of around 280 miles. The couple have known each other for around four years having met online through an online gaming website. They had been dating for around 11 months before the start of this study. The couple have always lived at a distance from one another. The participants received no incentive for taking part in the case-study as with the sleepyWhispers case study. The participants responded to an emailed advertisement, expressing interest in the trial as something that might contribute to their relationship.

The sleepyWhispers participants were a male-female couple both aged 27 at the time of the study. The female of the couple had previously taken part in the interview studies where she was known as P3. Throughout this Chapter, the female participant will use the identifier 'pZ' and the male 'pK'. pZ currently lives in Bath, UK and pK in London, UK, a distance of around

115 miles. The couple have known each other for around eight years and have been dating for four and a half years. Of the years they have been together, the first two years they lived in the same city (Bath for a year and then London for a year) but not in the same house. For the last two and a half years the couple have been living as a long distance relationship. The couple received no incentive, financial or other, for taking part in the case study. The participants responded to an emailed advertisement, expressing interest in the trial as something that might contribute to their relationship.

The hotHugs participants are a male-female couple, both aged 19 at the time of the study. Throughout this Chapter, the male participant will be referred to as 'pAl' and the female as 'pLu'.

pLu currently lives in Bath, UK and pAl in Brighton, UK, a distance of around 125 miles. Brighton is also pLu's home town. Prior to dating, the couple had known each other for around three years, having met at school. The couple had been dating for around a year prior to the start of this study. The couple were living in the same city for six months prior to pLu moving to University. Each participant received a £50 payment for taking part in the case-study. The participants responded to an advertisement on a poster, expressing interest in the trial as something that might contribute to their relationship. A financial incentive was included as an initial round of adverts had failed to recruit any willing participants.

pAl wanted to emphasise that his medical condition affected his ability to sustain personal connections:

"I don't know if it's worth mentioning that currently I have depersonalization/derealization due to anxiety/slight depression. So, being connected to someone is quite hard for me sometimes" [pAl - contact diary]

Finally, the hotMitts participants were a male-female couple, the male aged 18 and the female aged 16 at the time of the study. Throughout this Chapter, the male participant will be referred to as 'pM' and the female as 'pT'. pM currently lives in Bath, UK and pT in Chorley, UK, a distance of around 195 miles. Chorley is also pM's home town. The couple have known each other and been dating for around 11 months prior to the start of this study. For the first five months of their relationship, both participants lived in the same town (but not the same house). For the seven months prior to the start of the study they have been living at a distance. Each participant received a £50 payment for taking part in the case-study. The participants responded to an advertisement on a poster, expressing interest in the trial as something that might contribute to their relationship. A financial incentive was included as an initial round of adverts had failed to recruit any willing participants.

9.2 Methodology

Although the methodology for each case study corresponds roughly with the methodology we discussed in Chapter 8 there are some specifics regarding each case study which need to be reported.

Our doodleMessenger participants completed both diaries and the two interviews were carried out with the couple over IM. In addition to the 'standard' questions (see Chapter 8), Table

9.2 shows the questions which guided this semi-structured interview towards the particularities of doodleMessenger.

General Questions • In terms of the content of the pictures; what kind of things did you send and how did you personalise them? • Did any of the photos relate to particular memories/events that you shared? • Did you find much of a difference between doodleMessenger on the tablet to the phone?
Design Facet Questions • What were your thoughts about the personalised aspect of the notes? • Did you spend much time/effort making the notes? Why? • What did you think about using a system based on sharing doodled notes? • What are your thoughts about potentially using doodleMessenger with people other than each other? E.g. friends, family. Did you during the study period? • How did you respond to receiving a note? With a doodleMessage or something else? Why? • What are your thoughts about only being able to leave your partner messages? What would you think about having the ability to 'doodle' a message together with your partner? • What did you think about only having the doodles in digital form?

Table 9.2: The Interview Questions for the Second doodleMessenger Interview

Additionally our participants shared 5 doodles with us, explaining why they were particularly significant to them. Three of these notes can be seen in Figure 9.4.

Both the Daily Diary and the second interview referred to facets of the methodology. The main complaint was that the effort of completing the diaries was limiting how much the couple communicated:

"I think she is trying to talk to me less so she doesn't have to log the contact that we have in the other diary" [pA - daily diary]

"I feel we are avoiding talking so we do not have to fill in these diaries" [pB - daily diary]

"we spoke less because we had to log all contacts" [pB - second interview]

"I'm glad it's over and I can talk to pA again" [pB - second interview]

Such complaints are worrying as they suggest that the couple's communication habits changed because of the effort involved in completing the diaries. That said, such comments indicate that the diaries are highly likely to be an accurate reflection of what communication actually occurred.

We also directly asked our participants whether they would have shared different notes if we had been storing a copy of all of the doodles they created and shared. Although pB stated that she wouldn't have changed any of her notes (or sent any additional ones), pA would have sent fewer notes:

"I don't think I wouldn't have sent any of the ones I sent... but there would be situations where I probably wouldn't send because you could see them" [pA - second interview]

This validates our decision not to store all of the doodles but allow the participants to use the application as they typically would.

Our MSD participants only completed one diary each; pR completed the daily diary but did not complete the contact diary. pC completed the contact diary but not the daily diary. In both cases, the effort involved was quoted as the reason for not completing the diaries. A single interview was carried out with the couple over IM after the participants had finished using the MSD. In addition to the 'standard' questions (see Chapter 8), Table 9.3 shows the questions which guided this semi-structured interview towards the particularities of the MSD.

Design Facet Questions

- What kinds of messages did you send? Why?
- Do you think you would have sent different/less messages if we had been keeping a copy?
- Was there a pattern to when you sent messages?
- How did you find the tangible aspect (getting physical notes) of the system?
- Where did you put the printers? What did you think about hiding the printers? Did it change how you thought about the messages you received?
- How did you come across the messages you'd received? Did you look for them or come across them randomly?
- What were your thoughts about the personalisation-aspect of being able to draw messages?
- What were your thoughts about investing effort into drawing the notes?
- Would you like to have been able to send notes to people other than each other? (imagining that everyone had an MSD)

Table 9.3: The Interview Questions for the Second MSD Interview

Figure 9.5 shows a selection of sample notes sent through the MSD. We shall discuss the exact content of these notes when discussing the couple's routine in using the MSD.

The sleepyWhispers couple were diligent in completing the Contact Diaries. However, they chose not to complete the Daily Diaries, stating that they didn't feel that their thoughts and feelings differed enough on a daily basis to warrant restatement. Although disappointing, we must acknowledge that the participants were already committing themselves to the expenditure of a large amount of effort by taking part in the study without any extrinsic reward. The lack

of daily data does limit some of the analysis we would have liked to have performed, especially with regards to the daily Closeness ratings.

The first sleepyWhispers interview did not take place with pZ as this information had previously been elicited from the interview studies. An informal discussion with pK took place to ensure that he agreed with the analysis of this data.

A second interview was undertaken separately with both pZ (face-to-face, audio recorded and transcribed) and pK (via IM). In addition to the 'standard' questions (see Chapter 8), Table 9.4 shows the questions which guided this semi-structured interview towards the particularities of sleepyWhispers. The intention of this interview was to better understand how our participants used sleepyWhispers within their relationship and what they thought about specific design facets of sleepyWhispers.

General Questions
• How did you find the interface? • What did you think about using the pillows? Did it change how you thought about the messages?
Design Facet Questions
• What kinds of messages did you send? Why? • Do you think you would have sent different/less messages if we had been keeping a copy? • Was there a pattern to when you recorded/sent messages? • How did you find the 'listen-once' feature? Did you download any messages? If so, why? • If you were not aware of the feature, do you think you would have used it? If not, why? If so, for which messages? • When did you listen to the messages?

Table 9.4: The Interview Questions for the Second sleepyWhispers Interview

After discussions with the participating couple, we did not store a recording of each sleepyWhispers message as the couple were unprepared to use the system unless we could guarantee their messages would remain private. However, the participants did agree to allow us to store a log of when messages were sent.

The hotHugs participants completed both diaries and the two interviews were carried out with the couple over IM. In addition to the 'standard' questions (see Chapter 8), Table 9.5 shows the questions which guided this semi-structured interview towards the particularities of hotHugs.

Our hotMitts participants completed both diaries and the two interviews were carried out with the couple over IM. In addition to the 'standard' questions (see Chapter 8), Table 9.6 shows the questions which guided this semi-structured interview towards the particularities of hotMitts.

General Questions
• Did you use hotHugs with other communication technologies? Which ones? Why those specific ones? • How did you find the soft-toy interface? Did you have any thoughts about alternative interfaces or other ways of improving the system?
Design Facet Questions
• What were your thoughts about being able to personalise the belts? What about selecting the soft-toys? • What did you think about using a device based on hugging? • What are your thoughts about potentially using the hotHugs with people other than each other? E.g. friends, family • What did you think about using heat as a way of communicating with each other? • What are your thoughts about only being able to use the belts together at the same time? What would you think about having the ability to 'leave' your partner a hug to receive later on?

Table 9.5: The Interview Questions for the Second hotHugs Interview

General Questions

- Did you use hotMitts with other communication technologies? Which ones? Why those specific ones?
- Having used the hands with both a timed amount of heat and an instant change, do you have any thoughts about which was better? Why?

Design Facets Questions

- How did you find making the hands? How (if at all) do you think making the devices changed how you thought about using them?
- What were your thoughts about being able to personalise the hands?
- What did you think about using a device based on holding hands?
- What are your thoughts about potentially using the hotMitts with people other than each other? E.g. friends, family
- What did you think about using heat as a way of communicating with each other?
- What are your thoughts about only being able to use the hands together at the same time? What would you think about having the ability to leave your partner a hand-hold receive later on?

Table 9.6: The Interview Questions for the Second hotMitts Interview

9.3 Note Based Systems

We start by discussing the results of the doodleMessenger and MSD case studies. In terms of our doodleMessenger participants, pA recorded 102 acts of communication, pB 100. We additionally have the data from the Daily Diaries and the interview transcripts.

From the MSD participants, pC recorded 81 acts of communication, we have no such data from pR. We additionally have the data from pR's Daily Diary and the interview transcript.

We begin our analysis by considering the first of our questions: how do our case study participants communicate and how did doodleMessenger/MSD fit into that pattern?

9.3.1 Routine/Communication Ecology

The doodleMessenger couple have a fairly well structured communication routine. Phone calls typically occur in the evening with Skype being used occasionally when it has been pre-arranged:

"I would ring him every night before I go to bed or if I was bored on my way home" [pB - first interview]

"I'm glad we could video on Skype as it makes me feel closer to him" [pB - daily diary]

Messaging technologies (specifically SMS and whatsapp) are used predominantly during the day as they are more convenient but still allow the doodleMessenger couple to feel as though they are involved in one another's lives:

"we text and whatsapp in the day and call or face time in the evenings" [pA - first interview]

"typically photos I've taken of stuff I've seen around" [pA - first interview]

Calling one another was considered to be better at forming an emotional connection, particularly as it allowed synchronous feedback. In comparison, messaging technologies were disliked as they were hard to use in an expressive way:

"I would say calling is more emotional. I like being able to actually hear pA and his response to things... however at work when I am busy I still want to talk to pA and messaging is easier so that is more convenient" [pB - first interview]

"Today I was more aware of the distance between us as I had a really nice weekend and wanted to tell pA all about it but found SMS frustratingly slow to have a conversation which was why I called him instead" [pB - daily diary]

The MSD participants had a similar routine with the telephone being used for more 'important' acts of communication, aimed at generating a feeling of closeness between the couple while SMS was used more to remain connected during the day. Other technologies, such as Spotify, Facebook and Whatsapp, appear to have been used more to exchange humorous messages or notes based around personal idioms.

Being involved in one another's lives was important to the doodleMessenger couple and although messaging technology assisted in this, it also highlighted experiences which the couple couldn't share:

"Good although I know she has people visiting tonight so I'm a bit annoyed I'm not there (even though it's my fault I couldn't go" [pA - daily diary]

"appreciate pA so much as he helped me prepare for my assessment today" [pB - daily diary]

Shared experiences have been mentioned by pR in the past (see Section 6.2.3), described as being able to live their lives together, something which is difficult to achieve at a distance. There is some evidence from the MSD couple's diaries of the couple trying to create such shared experiences already. As communicating shared experiences are currently unsupported by technology, the couple had to use a mish-mash of systems designed to be used for different purposes:

"I asked him to take his laptop drumming so [my friend] and I could watch him play" [pC - contact diary]

"it was fun to play while she and her mate watched" [pR - daily diary]

The doodleMessenger couple meet up around every two weeks, typically at pB's as her house is more amenable to them being together. Although being together is emotionally rewarding, it does have a cost in terms of highlighting how long it will be until the couple can see one another again:

"we met up today... that made me in a good mood all day!" [pA - daily diary]

"I feel good about our relationship, although not now being able to see him for a few weeks is a bit upsetting" [pB - daily diary]

The MSD couple manage to meet up around "every 2 to 3 weeks" [pC - interview] in both Bath and Durham. Although these meetings are appreciated by the couple, they do generate negative emotional experiences when such meetings come to an end. Even this sadness is not without tinges of relational support; although they are sad that they are parting, the fact that you partner is also sad made them feel appreciated and made them feel loved:

"[I felt] slightly sad because he [pR] was leaving... he was feeling sad about going back so yes, a little [felt appreciated]" [pC - contact diary]

"I miss her, it is difficult when you're suddenly apart after being together for a while" [pR - daily diary]

Although the doodleMessenger couple would like to see one another more often, the couple have always lived apart. This means that although they recognise it might not be ideal, their communication routine is sufficiently emotionally rewarding that the relationship is sustained:

"the relationship was started long distance so I guess if I don't like it I wouldn't be with him to start with if you know what I mean" [pB - first interview]

The doodleMessenger couple's self-description of their communication routine is corroborated by the data reported in the couple's Contact Diaries, as can be seen in Figures 9.1 and 9.2. The MSD couple's self-description of their communication routine is corroborated by the data reported in pC's Contact Diaries, as can be seen in Figure 9.3.

Anomalous Results

Similar to the other case studies, the graphs do display a distinct grouping of anomalously low results based on the expectation from the literature that face-to-face and telephones should generally score higher SP scores than other media. Unlike those case studies, these results

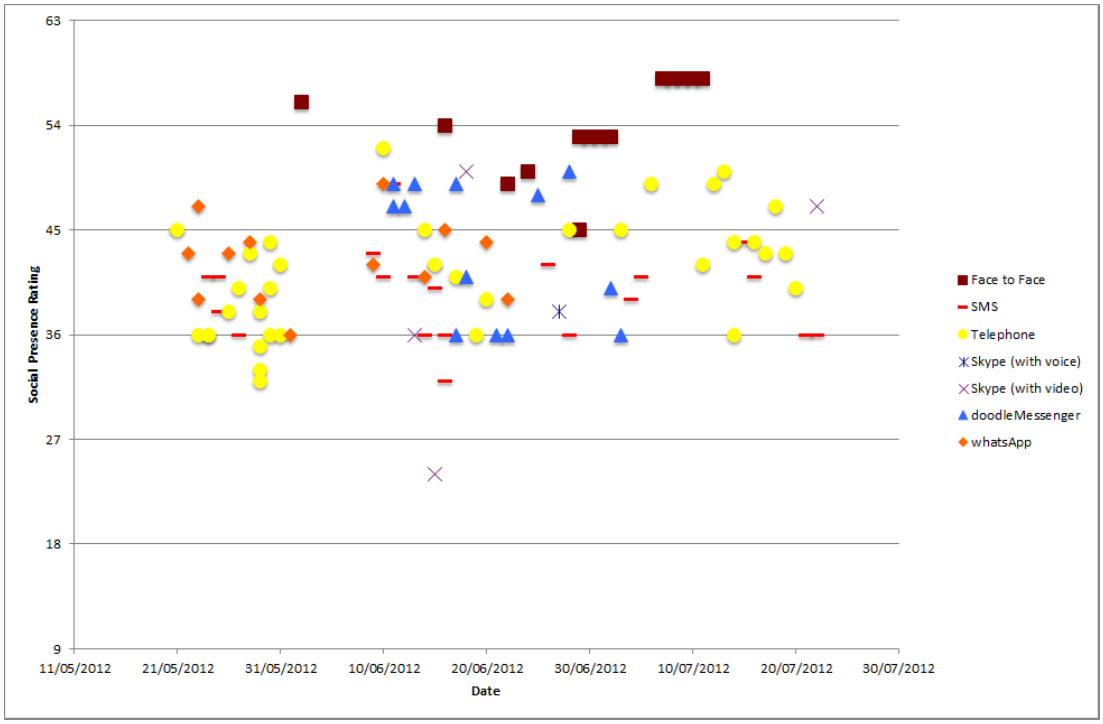


Figure 9.1: A graph showing pA's SP data by Medium and time

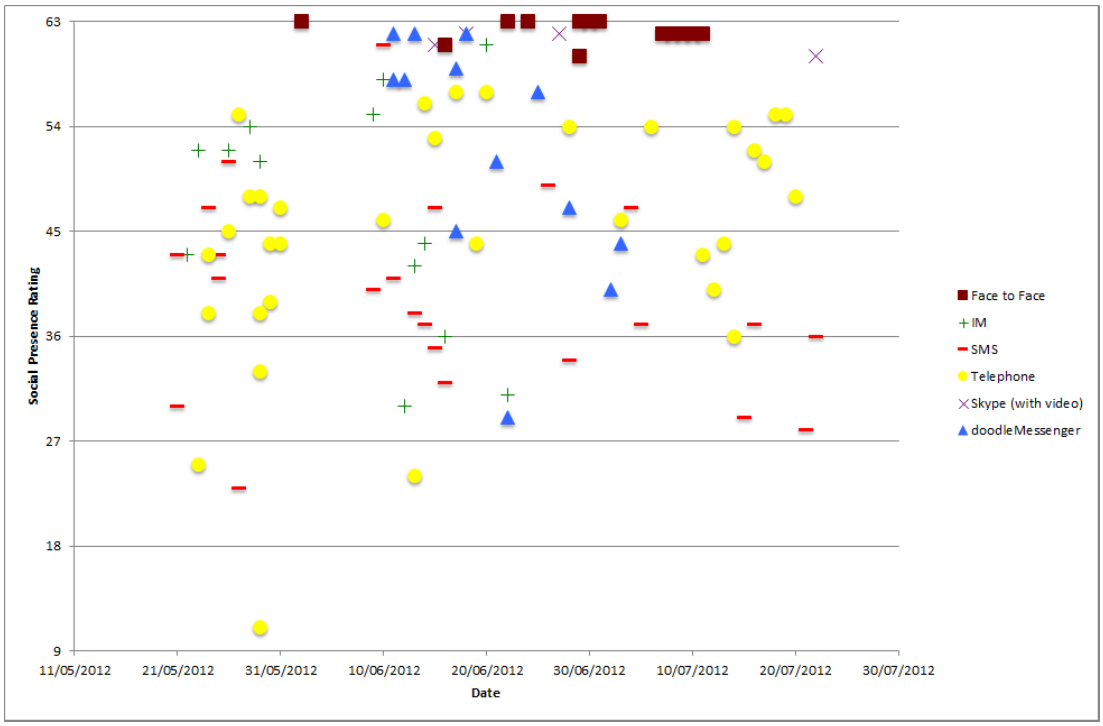


Figure 9.2: A graph showing pB's SP data by Medium and time

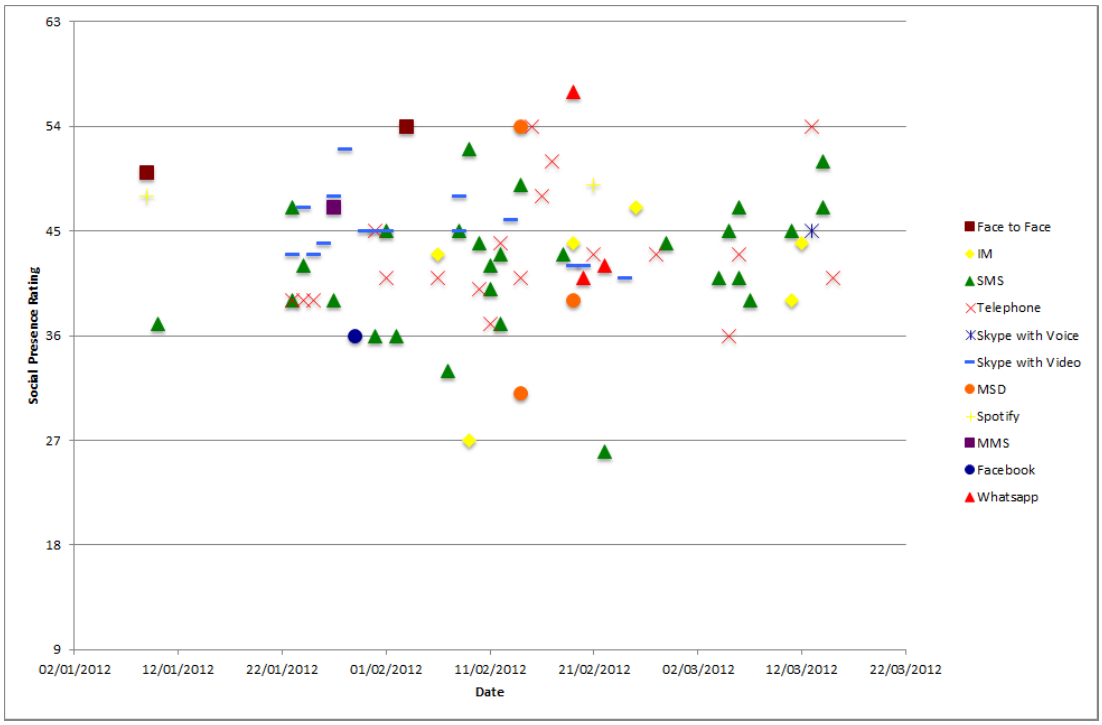


Figure 9.3: A graph showing pC's SP data by Medium and time

do not conform to a pattern (e.g. tiredness for sleepyWhispers, arguments for hotHands) but instead appear to be simply negative experiences. These range from missing each other to being tired, from being annoyed at particular communication technologies to having a bad mood. Given this range of reasons, these results do not appear to be anomalous or a group of similar communicative acts. As such there is no need to compare the SP results of these low results against 'normal' acts of communication.

The MSD graph shows no clear anomalous results which need further consideration.

doodleMessenger Routine

The doodleMessenger and MSD couples had rather different routines regarding how they integrated the device into their everday life. We will first consider doodleMessenger. The couple had a pre-existing routine of using whatsapp to exchange photos in order to remain connected to one another:

"whatsapped for a while in the afternoon which made me feel good but then missed her afterwards" [pA - daily diary]

"even though we have been busy we still had the opportunity to send silly messages and make each other laugh" [pB - daily diary]

DoodleMessenger fitted into that routine by encouraging the creation of doodles (or the annotations of photos) which could then be shared in a similar fashion:

"I liked being able to annotate pictures and being able to send through whatsapp" [pA - second interview]

We discuss the exact type of content created and shared through doodleMessenger in the next Section. However, it is worth noting that the participants enjoyed using doodleMessenger as it created new ways of communicating with each other:

"doodleMessenger definitely provides other conversation themes and methods of conversing that would not be possible otherwise" [pA - daily diary]

Doodles were not used 'very often' but were used in situations which would be meaningful either to the creator (they wanted to feel connected) or the receiver (they were undertaking some activity):

"we didn't doodle very often... I think it's something I would choose to use every now and then to augment the other ways we talk"

Doodles were not normally responded to by another doodle though this was due to the method of exchange rather than an aspect of the notes:

"normally I would respond via text or whatsapp, but that's only because it came in via email and email doesn't feel like something she'd see straight away" [pA - second interview]

To summarise our findings regarding the importance of the doodleMessenger couple's communication routine, we need to focus on the clear split of technologies. Synchronous voice systems (Skype and telephone) were used in the evening, sometimes scheduled in advance, and were considered to be emotionally and relationally meaningful. Asynchronous messaging system are used to help the couple remain 'connected' even if they are less emotionally meaningful than the synchronous technologies. Finally we should note that the emotional closeness of being together is far greater than any of the technologies our participants used.

Turning our attention to the MSD couple, we must start by stating that the MSD installation was not seamless; it suffered from technical faults, predominantly based around network issues meaning that some notes were not received after they had been sent.

Using the MSD was generally considered to be "fun when it worked" [both pC and pR - interview]. That is, the system itself was a good idea but the technical faults did lead to negative emotional experiences:

"very frustrating, I spent 15 minutes drawing a 3 part story and pR only received the last picture" [pC - interview]

Such frustration led to a sense of hesitation around using the system:

"I was less willing to spend time on it" [pC - interview]

"you become hesitant due to the risk" [pR - interview]

The uncertainty over whether the system was working at a particular time led to the participants checking whether messages had been received by other means, such as SMS messages or sending messages during Skype calls. This layering of channels to send 'did you get it' style messages through other communication systems is quite distinct from the situation we have previously described where specific channels are used to exchange messages with different meanings. The reason that these additional layers had to be used in conjunction with the MSD is due to technical failure rather than a desire to supplement the MSD with other messages.

"also sometimes we would send things and then want to know if they had been received" [pR - interview]

"I asked if he got my MSD message... annoyed because he didn't get it" [pC - contact diary]

The technical uncertainties had a substantial impact on how participants regarded the system and their experience of using it. This demonstrates the importance of providing a high level of technical support when running studies such as these – as we argue earlier, field studies and reliably unreliable.

Technical faults also highlight the need for features to help mitigate any problems experienced. In the case of the MSD, pR argued strongly for keeping a local copy of notes created and having the option to resend them:

"or resend them once they were drawn" [pR - interview]

Such features could mitigate any shortcomings in devices which are, ultimately, prototypes.

MSD notes tended to be sent on a whim, with no pre-planning. This was however limited to times when the sender was in their home location. As pR said "when I was sitting there and I thought I'd send a message" [pR - interview]

Other notes were sent after considering conversations carried out through different technologies:

"I remember a couple of times where we were having, or had just had, a conversation on Skype and I sent a note during/after... for example, I remember sending one about needing a shave in that way" [pR - interview]

This routine of sending notes works well for the type of content hat they contained - typically romantic or humorous messages.

Thus far we have discussed how our participants communicated and what this routine can tell us about their experiences of SP. We now move on to discuss what (if any) impact doodleMessenger and the MSD had on their communication experiences.

9.3.2 Routine of doodleMessenger

Having discussed our participants 'normal' communication routine, and how doodleMessenger fitted into that routine, it is now necessary to analyse more deeply how doodleMessenger affected their relationship. In other words, did doodleMessenger help support the distant couple and if so, why?

Having no log of the sending of doodles, the starting place for this analysis is to investigate whether there is any difference between the stages of the study (pre-use, during-use and post-use of doodleMessenger). Table 9.7 shows the results of comparing pA's Daily Closeness scores by study phase. There appears to be a difference between the Closeness ratings for each study stage.

Study Phase	N	Mean Closeness Score	Standard Deviation
Pre-	12	4.92	1.26
During-	29	5.83	1.08
Post-	15	6.27	0.77

Table 9.7: Means of pA's Daily Closeness scores for each phase of the study

Table 9.8 shows the results of comparing on pB's Daily Closeness scores by study phase. There appears to be no difference between the Closeness ratings for each study stage.

Study Phase	N	Mean Closeness Score	Standard Deviation
Pre-	12	5.50	1.38
During-	29	6.41	0.62
Post-	15	6.13	0.96

Table 9.8: Means of pB's Daily Closeness scores for each phase of the study

There is no evidence to suggest that doodleMessenger has enough of an impact to change pB's feelings of Closeness towards pA.

There are three interpretations as to why pA's data shows a significant difference across the three phases of the study. The first interpretation is that doodleMessenger had an impact on the couple's relationship and that this impact continued after using the software. The second interpretation is that reflecting on the relationship (through completing the diaries) had an impact on how pA thought about their relationship. The final interpretation is that the difference reflects a deepening of the couple's relationship. As their relationship is a relatively new one which is still forming, the difference in Closeness could be an artefact from the development of their relationship. This is the interpretation which we feel is most likely.

We now move on to discuss the Social Presence scores on a per-communication media basis.

Table 9.9 gives a breakdown of the SP scores, across all phases of the study, by Participant and Communication Media. This raw data helps to inform our analysis of the impact doodleMessenger was having.

Communication Media	**pA**			**pB**		
	SP			**SP**		
	Mean	**SD**	**n**	**Mean**	**SD**	**n**
Face to Face	54.00	4.02	14	62.23	0.93	13
IM	-	-	-	46.85	10.05	13
doodleMessenger	43.38	5.92	13	51.85	10.24	13
whatsApp	42.38	3.59	13	-	-	-
Telephone	41.20	5.00	35	44.91	10.34	34
SMS	39.82	3.84	22	39.39	8.60	23
Skype with Video	39.25	11.81	4	61.25	0.96	4
Skype with Voice	38.00	-	1	-	-	-
Total	42.98	6.66	102	47.70	11.55	100

Table 9.9: Breakdown of Social Presence scores by Participant and Communication Media for all data

Face-to-Face communication is ranked highest in terms of Social Presence. The next banding consists of doodleMessenger, whatsapp and Skype (with video). The next banding consists of the telephone and IM, with the lowest banding consisting of SMS.

Given that doodleMessenger was designed to support distance relationships through creating the opportunity to share communication acts with high Social Presence, this result is positive given that it indicates that doodleMessenger achieves this aim.

9.3.3 Routine of the MSD

Having discussed the doodleMessenger SP results, let us consider the MSD results.

Having no log of the sending of notes, the starting place for this analysis is to investigate whether there is any significant difference between the stages of the study (pre-use, during-use and post-use of the Magic Sock Drawer). Table 9.10 shows the results of comparing pR's daily Closeness scores by study phase. There appears to be no difference between the Closeness ratings for each study stage.

Study Phase	N	Mean Closeness Score	Standard Deviation
Pre-	14	5.21	0.86
During-	28	4.71	1.03
Post-	8	5.25	0.66

Table 9.10: Means of pR's Daily Closeness scores for each phase of the study

There appears to be no significant difference in Closeness between which phase of study the participants were in. We have no evidence to suggest that the Magic Sock Drawer had enough of an impact to change our participants' feelings of Closeness against their normal communication routine.

The next step is to investigate whether there is any significant difference between the different communication technologies our participants used.

Table 9.11 gives a breakdown of the Social Presence scores, across all phases of the study by Communication Media. This raw data helps to inform our analysis of the impact the MSD was having.

Communication Media	**Contact SP**		
	Mean	**SD**	**n**
Face to Face	52.00	2.83	2
Spotify	48.50	0.71	2
MMS	47.00	-	1
Whatsapp	46.67	8.96	3
Skype with Video	45.07	2.87	15
Skype with Voice	45.00	-	1
Telephone	43.11	5.24	19
SMS	41.96	5.59	28
MSD	41.33	11.68	3
IM	40.67	7.17	6
Facebook	36.00	-	1
Total	43.30	5.71	81

Table 9.11: Breakdown of pC's Social Presence scores by Communication Media

Face-to-Face communication has the highest Social Presence score. The next banding consists of Skype, Spotify, MMS and whatsapp followed by a banding containing IM, SMS, the telephone and the MSD. The lowest banding contains Facebook.

(a) A giraffe doodle

(b) A photo annotation

(c) A doodle of campus

Figure 9.4: Example notes sent through doodleMessenger

From the Social Presence data, we are in a position to argue that the Magic Sock Drawer was not associated with particularly high levels of Social Presence compared to other communication media. Before considering some of the specific design facets which failed to create an emotional connection, we must discuss our participants reflections on using the Magic Sock Drawer and how it impacted their relationship. This analysis is derived from the interviews we conducted with the participants after using the system.

Before discussing how the design facets built into the software, we must first turn our attention to the interview data we have collected to better understand how our participant's used doodleMessenger/MSD and the impact the software had on their relationship.

Content

From analysing the doodles our participants exchanged, there is a clear distinction between annotations of photos (see Figure 9.4b) and free-form drawings (see Figures 9.4a and 9.4c). Participants had a clear understanding of this split:

"wrote messages on them or drew things over the top" [pA - second interview]

"stupid pictures... like a penis" [pB - second interview]

"I made pA a landscape" [pB - second interview]

The annotations were a continuation of the couple's existing practice but instead of exchanging photos with text notes; the couple starting adding those notes onto the photo. The free-form drawings were a new means of communicating, one which was predominantly based around jokey messages:

"Amused, I wanted to see how long it would take for her to tell me that I made her feel sick. It didn't take long" [pA - contact diary]

"pA sent me a doodle of what he was eating which made me laugh" [pB - daily diary]

"pA first sent a rude doodle to me as a joke to make me smile... the doodle was only sent because he was bored and wanted to make me laugh. It worked" [pB - daily diary]

Analysing the MSD notes, three types of content were identified – technical checks, personal idioms/humour and romantic notes. Table 9.12 shows how many notes from each participant contained each content type. Figure 9.5 shows an example of each content type from each participant.

Participant	**Technical Check**	**Personal Idiom/ Humour**	**Romantic**
pR	1	3	3
pC	4	9	2

Table 9.12: The breakdown of MSD notes by participant and topic

The content of the notes corresponds with what we might expect for a relationally meaningful system; a large proportion are of a humorous or romantic nature (presumably to foster feelings of closeness). The remaining notes are intended to check whether the system is working at that time (not guaranteed due to technical issues). Such humour is unsurprising given that it corresponds with how the couple think of their relationship.

The MSD was used for such purposes as it was different from other technologies. As other media were used for 'serious' communication, the couple were free to explore the more 'fun' side of their relationship and utilise the ability of the MSD to produce playful notes:

"we talk so often on other means, we didn't need to use it to be serious, it was a novelty so we used it more for fun" [pC - interview]

"it was complementary, something extra to be used" [pR - interview]

"it didn't replace anything for us because there was nothing it shared with phone calls, Skype [or] texts" pC - interview]

Impact

The doodles were intended to be personal and to connect the couple together:

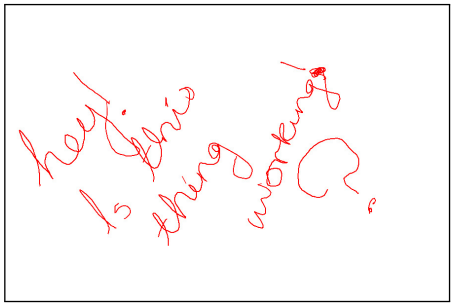
"[the doodles were used] to cheer someone up or appreciate someone" [pb - second interview]

"I think it was more personal than text or photos or email or whatever... but not as much as phone calls or facetime" [pA - second interview]

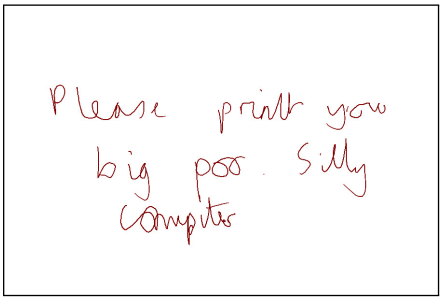
That said, the couple didn't think that doodleMessenger made a substantial, long-term impact on their relationship:

"I don't think there is much difference in our relationship" [pB - second interview]

It is worth noting that only pB expressed this view. pA's data indicated that doodleMessenger may have had an impact on his feelings of Closeness towards pB.

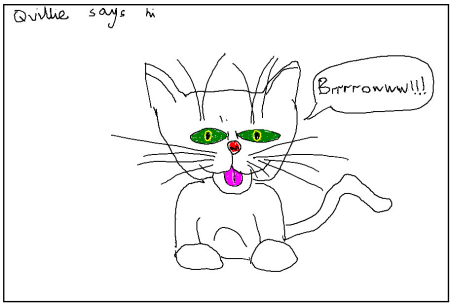


(a) A technical check note from pR

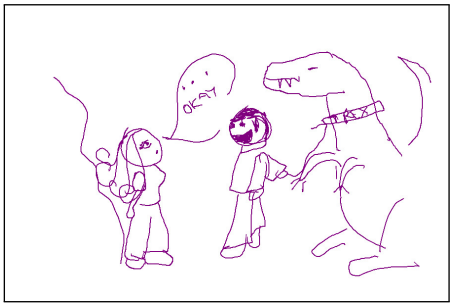


(b) A technical check note from pC

(c) A personal idiom note from pR

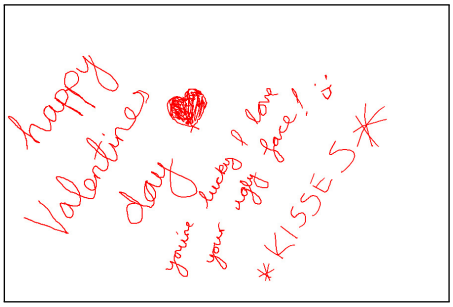


(d) A personal idiom note from pC

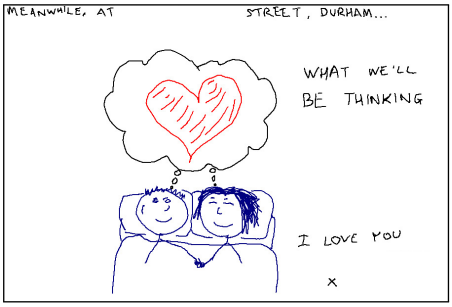


(e) A personal idiom note from pR

(f) A personal idiom note from pC



(g) A romantic note from pR



(h) A romantic note from pC

Figure 9.5: Example notes sent through the MSD

Receiving a note made the recipient feel appreciated and valued:

"yeah I liked it, I felt appreciated" [pA - second interview]

"I liked it, it was exciting because pA put effort into it and it meant something" [pB - second interview]

Even if the effort involved in creating the note led to a need to reply:

"I prefer receiving them but getting one made me want to send one back to make pA feel how I felt when I got one" [pB - second interview]

The best indication of the impact of doodleMessenger is the participants' desire to continue using a system similar to doodleMessenger. The couple would be more tempted to use doodleMessenger itself if it integrated properly into their existing routine (e.g. worked with whatsapp) and if there was an iphone version:

"if it were more convenient I'd probably carry on doing that" [pA - second interview]

"I would use it more... I would be more inclined when sending pA a photo to doodle on it then leave it blank like I do at the moment" [pB - second interview]

"I may still send annotated pictures but honestly I'd probably use another app that had better colour stuff" [pB - second interview]

Having Fun

The MSD was used exclusively by our participants to exchange 'fun' messages which were considered to help maintain their relationship, albeit in a different way:

"it is not a medium for arranging a holiday, let's say... it was more about sending things that maintain our relationship in a different way" [pR - interview]

As the medium encourages the creation of messages based on humour and personal idioms, the notes were fun to receive. This fun also encouraged the couple to think about each other:

"entertained me and made me laugh when drawing something, made me think about pR more... when receiving something it usually made me happy and feel affectionate towards pR. As in, we're not together [but] he's still thinking about me kind of thing" [pC - interview]

The notes were considered to be nice when they were received but to have no longer-term meaning beyond that. Given that pC later displayed some of the notes in her house (see Figure 9.6) we would argue that the notes do hold some form of long-term value, even if it is not recognised by our participants.

"I guess it helps promote feelings of closeness even when distance is an issue... it hasn't affected our relationship but at the time it did make me feel a little closer to pR. It made us laugh together and think of each other which was nice" [pC - interview]

Having discussed how doodleMessenger and the MSD had an impact on our participants' relationship, we now move on to discuss the underlying design facets of doodleMessenger and the MSD and our participants' thoughts on these particular factors.

Figure 9.6: Some of the MSD notes displayed in pC's home

9.3.4 Design of doodleMessenger and the MSD

Thus far we have considered the couple's communication routine and the impact that doodleMessenger had upon that routine. We've seen how the system helped to form a close connection between the couple, particularly through the use of humour. We will now delve deeper into the particular design facets built into doodleMessenger (namely metaphor, personalisation, effort, sensory medium, one-to-one, serendipity and availability) affected our participants view of the software and how it impacted their relationship. This ordering discusses the design facets in the order presented at the end of Chapter 6 before discussing other issues.

Metaphor

Let us first consider the metaphor behind doodleMessenger. Given our participants extensive use, and high SP/Closeness scores, it is not surprising that our participants had no problem with the note-sharing metaphor behind doodleMessenger. Indeed, if anything, our participants were slightly surprised with the question:

"yeah I was comfortable doing it" [pA - second interview]

"it is like the picture on the fridge" [pA - second interview]

It is unclear whether the underlying note-sharing metaphor had any deeper relational meaning beyond our participants enjoying using the software.

Personalise

Both doodleMessenger and the MSD allows participants to personalise the messages they send. Indeed, offering a free-form style of message, it is hard to conceive of a non-personalised doodle. This ability to personalise messages was liked:

"it was nice to be able to personalise pictures" [pB - second interview]

"it was nice just to be able to make photos a bit more personal" [pa - second interview]

That said, our participants struggled to verbalise the impact that this personalisation had; although it seems to have encouraged the humorous content of the doodles, they struggled to compare doodleMessenger to other communication media:

"I liked being able to personalise things it was nice, but really context dependent. I feel it's quite hard to compare to other forms of communication" [pA - second interview]

Similarly, our MSD participants did not talk much about the ability to craft notes which were personalised, beyond the fact that the drawing interface allowed the free-form creation of fun notes.

"it was fun" [pR - interview]

"it gave you freedom to do whatever you liked" [pC - interview]

From our analysis of the content of the notes, we can observe that a substantial majority of the notes are of a personal nature – notes which could not have been created in an impersonal way.

The free-form nature of the messages which doodleMessenger allows gave our participants the opportunity to share messages based on shared experiences and memories:

"I drew a picture of a giraffe because we went to the zoo recently and liked them" [pB - second interview] (see Figure 9.4a)

"pA drew a picture of his mint ice cream because its both our favourite" [pB - second interview]

"we recently went to the zoo and loved the giraffes and considering I could not sleep I had a lot of fun drawing this and spending the time to send pA something he would appreciate" [pB - contact diary]

These idiomatic messages are highly personal, utilising a shared understanding to create an emotional exchange. Although we have limited evidence, we can claim that the personalisation aspect of the system was so successful; our participants did not conceive of there being an alternative.

Effort

We have previously discussed how there was a clear divide in the content of the doodles between drawings and annotations. In terms of effort, drawings were considered more effortful than annotations:

"the drawings had a bit more [effort]" [pA - second interview]

This investment of effort means that the drawings were extremely appreciated:

"Appreciated! It was nice that she'd taken the time to do such a drawing... but also guilty that I hadn't taken the time to draw something so complicated" [pA - contact diary]

"he really appreciated the drawing I sent... therefore the 20mins spent on it wasn't wasted" [pB - contact diary] (see Figure 9.4a)

"really made me smile and made it my screen saver. Very sweet and must of taken him a lot of time and effort" [pB - contact diary] (see Figure 9.4c)

The substantial difference in appreciation is likely to be due to an understanding of the effort involved. Both participants created complex drawings meaning that they had experienced the effort invested into such a drawing. Therefore, when they received a effortful drawing, they appreciated it more.

In additional to the appreciation, effortful drawings had a substantial emotional impact:

"[I felt] good from the effort she went to in drawing a picture for me on doodleMessenger. It made me feel bad that most of the ones I've sent her have been photos with annotations" [pA - daily diary]

"I feel good still, and a bit better because I reciprocated on the picture that took ages to draw and she seemed to really appreciate it" [pA - daily diary]

The only downside of this appreciation and emotional impact was that if an individual had not sent a doodle recently with an equivalent level of effort then they felt a level of guilt. There was no indication that their partner expressed any kind of displeasure or disappointment that they had not received an effortful doodle. Such findings resemble those as experienced in the exchanging of gifts (e.g. [Mauss, 1954]).

Our MSD participants expressed similar views, noting that they appreciated the effort which was invested in creating the notes but were less keen on investing that effort themselves, particularly when some notes were not received by their partner.

"sometimes I got fed up with drawing it, I wanted to finish it" [pR - interview]

"I would have enjoyed it more if I knew the time I'd spent on it wouldn't be wasted by pR not receiving it" [pC - interview]

The emotional impact of the doodles, and the appreciation of the effort, resulted in our participants displaying them:

"I may have one as my phone desktop background... she put a lot of effort into it" [pA - second interview]

This is a point we will return to when discussing hard-copies.

In addition to the impact of the effort on participants, our data also highlights an interesting aspect of effort. Our data suggests that perceptions of effort are highly dependent on the context:

[appreciation question] "yes because although he was busy I could chat and walk around at the same time to keep me entertained" [pB - contact diary]

[appreciation question] "[whilst at a work dinner] yes because I would have been bored and lonely, pA knew this and took the time to talk to me]

Sensory Media: Hard Copy

The MSD distinguishes itself from other digital drawing systems in that the notes produced from the system result in a physical form. That is to say, the printing of the notes makes the system unique. The underlying reason for that tangibility from a design perspective is that we anticipated the notes being appreciated and valued more if they took a physical form. This appears to be the case with the merger of digital and physical being considered 'cool':

"it was really cool doing something online and actually being able to hold it and display it" [pC - interview]

pC carries a MSD note around in her purse; something that is impossible to do in a purely digital system.

"this may sound a little sad, but I carry one of them in my purse too" [pC - interview]

Additionally, pC has created a display of her favourite notes which has been placed at the top of her stairs where she can regularly see it and enjoy remembering about the notes (see Figure 9.6). This attachment to the notes indicates that the MSD messages are particularly valued.

Something which we did not anticipate is that the tangibility of the notes allows people to display the messages in a straightforward and accessible manner. Although it is possible to display digital artefacts (using digital photo frames for example) it is neither convenient nor are the displays easy to be seen.

"I made a little display of Ryan's drawings which I had on my wall, it was cool to look at them and have them with me. Reminded me of him when we weren't in contact" [pC - interview]

"I actually liked seeing that display when I went to her house, it made me see she valued the notes" [pR - interview]

The displays of notes are an interesting phenomenon. Wanting to display the notes demonstrates how valued the notes are to the receiver. The ability to repeated view the display reminds them of their partner every time that they see them. Additionally, when the person's partner sees the display, they themselves feel valued by their partner. All of these positive feelings stem directly from the tangibility of the notes which allowed them to be displayed in a meaningful way.

We've previously mentioned how the effort invested into some of the doodles led to pA using one of them as his phone background. This was the only place he thought he would see the image on a digital display:

"digital desktop is about the only digital place I'd put it realistically... I don't really look at photos on my phone" [pA - second interview]

pA had not taken part in any previous study but was aware of the Magic Sock Drawer. As such he was keen (similarly to some of our interview participants, see Section 6.2) on incorporating doodleMessenger with some kind of printer to create a system more like the MSD:

"being able to make hard copies would be cool, and those bluetooth things would be the way I would use them most I think" [pA - second interview]

The primary reason for wanted such a hard copy was to display it such that he could see it more often and enjoy it:

"I think the odd one or two might be worthy of a hard-copy which would make me see them more often" [pA - second interview]

"being able to stick them on my laptop or something... if it were just on paper I'd put them somewhere and never see them again" [pA - second interview]

We found no evidence that displaying it had anything to do with making the created feel appreciated when they say the note being displayed; displaying the note was more for personal pleasure.

One-to-One

One of the recurring concepts across these case studies is the openness of the system. doodleMessenger was not set up to be one-to-one; it had a high-degree of control behind the

sharing mechanism; allowing messages to be shared both privately and publicly (see Section 5.2.2). Neither of our participants sent messages to anyone other than each other:

"I didn't, no... [but] I could see me doing it but much more rarely" [pA - second interview]

However, they had no objection to sharing messages with anyone:

"I'd like to send friends stuff! That would be fun" [pB - second interview]

We can hypothesise that our participants did not share messages with other people partly due to the framing of doodleMessenger within the study.

Although they focussed on friends, this was mainly technological; their family don't possess smartphones. The messages they anticipated sending remained mainly humour based, indicating that this is a fundamental property of the system rather than being particular to our participant's relationship:

"I don't think I'd use it for anything serious whoever I was sending stuff to" [pA - second interview]

Similarly, the MSD was one-to-one by design; users could only send notes to their partners. The supposition was that this would increase the intimacy of the messages as users understand that only their partner could have sent them the message. This was not necessarily the case with the MSD. Both pC and pR discussed being happy to use the MSD with other people:

"I can't see why not" [pC - interview]

"I don't think I'd be too bothered" [pR - interview]

After considering it, they were particularly keen when thinking about friends and family who live at a substantial distance from them:

"it might be cool if my Saudi friends had something similar" [pC - interview]

We suggest that this disregard for the added intimacy of 1-to-1 communication is based on the type of messages sent through the MSD. Humour is not something which is exclusive to romantic relationships in the same way that intimacy is; humour is shared amongst friends, families, colleagues and strangers. Intimacy, like that shared by hotHands and hotHugs, is not something which is shared amongst so many people. On reflection then, it should not come as any surprise that our participants were content to share messages with people other than each other.

Serendipity

The MSD was intended to use serendipity as a key feature; that participants would stumble across notes and random times. We theorised that this would create a sense of connection due do finding out that you were being thought about when you were not expecting it.

Somewhat surprisingly, the couple did not always use the system in this way. Some notes were even sent as accompaniments to synchronous media such as Skype:

"I didn't always 'find' them, sometimes we were trying to send them while on Skype or whatever" [pR - interview]

This appears to be due to the technical uncertainties which plagued the couple's used of the MSD; simply sending the notes and expecting them to be found was not sufficiently reliable for our participants to trust for relationally meaningful notes. That said, when notes were found serendipitously, the experience was a pleasant one, leading to feelings of surprise.

"I liked the surprise when I did find a message I wasn't expecting" [pR - interview]

Availability

The MSD was designed such that it could only be used from a fixed location. Corresponding with opinions expressed during the interview studies (see Section 6.2.3), the couple wanted to merge the printing aspect of the MSD with creation of notes on a smart phone:

"I can envisage drawing the doodle on a phone and then having it sent to the printer, perhaps" [pR - interview]

The reiteration of this concept across both the design interviews and by participants who have used the system for a prolonged period of time indicates that the fixed-location of the MSD is a major drawback. People seem to want to have the freedom to create notes whenever they like. The reason that this concept appears with such regularity when discussing the MSD, as compared to, for example, the hotHands, is the nature of the message being communicated. Whilst other technologies are based around intimacy, the MSD and doodleMessenger appear to foster a sense of playfulness. Therefore, people want to create notes when they think of something humorous or playful to say, rather than have to remember the message for later by which point the moment for fun may have passed. As our doodleMessenger participants expressed delight over being able to create notes whenever they desired, availability appears to be an important facet of design.

Shared Experiences

The MSD couple desired to have the ability to collaborate on drawings and create shared activities. Such a feature gives the ability for the couple to have the feeling of a shared experience, the importance of which we have discussed previously:

"possibly let us collaborate on a drawing that had been reloaded and printed, to make a timeline" [pR - interview]

"you know those flip pads that you get where the stickman moves... we could make one of those using MSD notes, that would be awesome... but only have half of the notes so we would need to unite to see the full thing" [pR - interview]

Such features go beyond the current device but could be recognised as an element of the underlying device metaphor. 'Shared Experiences' are really a form of behaviour and as such, could be used to inspire the development of future devices.

Prototype Improvements

The first point to consider is that even though the doodleMessenger system was completely software-based, it must still be considered a prototype. The participants indicated that there

were two major issues with the system. The first was that the colour selector was not fit-for-purpose:

"the only thing I didn't like was the choice of colours" [pA - second interview]

"more colours, thinner and thicker likes" [pB - second interview]

More importantly, the difference between using doodleMessenger on the tablet and phone did change how our participants used the software:

"I would have sent him one back as it would have been more personal than a simple text message" [pB - daily diary]

"I would have used doodleMessenger if it was on my phone and didn't require wifi" [pB - daily diary]

"I'd say the lack of mobile data was probably the most inconvenient thing" [pA - second interview]

As pB did not have doodleMessenger on her phone, exchanging doodles during the day was not possible. Additionally, the tablet was not set up to receive MMS or whatsapp messages meaning that the exchange of messages was not seamless. Although these factors had an impact on how our participants used doodleMessenger, they did not appear to have an impact on how well doodleMessenger supported the relationship.

9.3.5 Discussion and Conclusion

DoodleMessenger was primarily used to exchange highly personal idiomatic notes. It was associated with a high level of Social Presence, highlighting it's ability to support the couple's relationship. pA's daily Closeness data also suggests that doodleMessenger may have increased his feelings of Closeness towards pB.

Most of the design space facets embodied in doodleMessenger were found to be positive. Our participants exchanged a lot of notes based on personal idioms and enjoyed the personalisation that the free-form drawing facilities could provide, even it they struggled to verbalise the emotional impact such personalisation generates. We have discussed at length how the doodles were more effortful than annotated photos and that this effort was both appreciated and had a high degree of emotional impact. The participants were comfortable with the note-sharing metaphor. Although pA in particular would have preferred the notes to be physical (as in the MSD) the fact that the participants displayed the notes is indicative that they appreciated the realised nature of the doodles. We have discussed these design facets at length throughout our analysis and have little to add at at this juncture.

The doodleMessenger case study has found that doodleMessenger was associated with levels of Social Presence akin to Skype with video and the telephone, partially answering RQ3. We have also explored our participant's views with regards to some of the design facets built into doodleMessenger, strengthening our answer to RQ2. We found that the design facets designed into doodleMessenger (namely personalisation, effort, openness and metaphor) were appreciated. In Chapter 10 we combine these findings with the results of the other four case studies in order to discuss how they assist us in answering our two primary research questions, RQ2 and RQ3.

Turning our attention to the MSD; our analysis has shown that our participants found that the MSD was useful in supporting their relationship. Despite being associated with low levels of SP, our participants liked receiving MSD notes even if they thought that the MSD would not have a longer term impact on their relationship. This does not correspond to pC displaying the notes in her home.

Many of the design facets built into the MSD were found to be positive. Our participants were comfortable with the note-sharing metaphor. The tangible aspect of the notes was liked by our participants as it meant that they could display the notes, reminding themselves of their partner every time they saw it. Although used exclusively for personalised communication, our participants struggled to verbalise why they liked this. Our participants appreciated the investment of effort into creating the notes although this was disliked when notes were not received due to technical errors. Although our participants enjoyed finding notes at random times, technical faults meant that our participants did not trust the system enough to rely on feeling notes serendipitously.

The one-to-one connection was considered to be a limitation of the Magic Sock Drawer. Due to using the system predominantly for fun messages, our participants saw no value in limiting who they could share notes with.

This case study has found that the MSD was associated with low levels of Social Presence, partially answering RQ3. We have also explored our participant's views with regards to some of the design facets built into the MSD, strengthening our answer to RQ2. We found that some design facets (namely fleeting/realised, serendipity and metaphor) were appreciated while others (such as personalisation and effort) were more complicated. In Chapter 10 we combine these findings with the results of the other four case studies in order to discuss how they assist us in answering our two primary research questions, RQ2 and RQ3.

9.4 Sound Based System

We now move on to discuss the results of the sleepyWhispers case study. pZ recorded 51 communication acts within her diary, pK 48. Additionally, we have the data from the analysed interview transcripts.

We begin our analysis by considering the first of our questions: how do our case study participants communicate and how did sleepyWhispers fit into that pattern?

9.4.1 Routine/Communication Ecology

The couple have a clear understanding of their routine; the main way they communicate is by a daily telephone call:

"yeah, we talk on the phone; I do text and email sometimes but mainly just talk on the phone and because we talk so often like every evening it sounds really stupid but I have it on the Bluetooth and I'm doing other stuff while I'm talking to him; getting ready for bed or whatever because we're quite often on the phone for a long time so if I talk to him and then did anything else it's just the time so setting anything up or whatever is just easier just to ring..." [pZ - handholding interview]

This daily call is the main method of staying connected to one another until the weekend which they tend to spend together, generally alternating between being in Bath and London.

These phone calls do have a set-back in that both participants have to be available at the same time to talk. Given the participants busy schedules this is not always possible, creating an opportunity for an asynchronous media such as sleepyWhispers to assist the couple. Additionally, having such a strong routine creates the unfortunate side effect of communication being exactly that: routine with no sense of surprise. Again, this is something which the sleepyWhispers system could help reintroduce into the relationship.

"it can be hard sometimes getting a time when you're both free to talk, even like in the evening... just finding that time can be difficult sometimes" [pZ - second interview]

" the phone call creates 'pZ time', I sit and chat but also I tend to have my laptop on as well" [pK - first interview]

"whereas every night I expect pK to ring me, it's not a surprise..." [pZ - second interview]

This is important as keeping in touch day-to-day, sharing the little things which have occurred, is an important factor in helping the couple feel close to one another another:

"I always find it odd because occasionally say one of us is out in the evening and we haven't been able to speak and then there's stuff which gets missed and suddenly I hate the feeling at the weekend I've discovered he's done something and hasn't told me [laughs] not cause like I want to track his ever move or anything but you kind of feel like if you speak every day you tell each other the little things that no one else would care about but it feels like you're living too far apart" [pZ - handholding interview]

In terms of other technologies, the couple have a clear strategy. Skype (or other video-conference type systems) are not used simply due to the strength of the couple's relationship with their daily telephone call.

"Probably not, just because I don't really use Skype or anything; I use Skype with my parents but not with pK, just because we talk so often" [pZ - handholding interview]

Email and SMS messages were sent for very specific purposes:

"Email tends to be for generally organizing life events - have you seen this kind of thing" [pK - first interview]

"[SMS are used for] short, instantaneous info exchange... or if I can't pick up the phone... or if I'm out and can't phone" [pK - first interview]

The couple's self-description of their communicate routine is corroborated by the data reported in the study contact diaries, as can be seen in Figures 9.7 and 9.8.

There are two additional points we should make clear about the diary data. The first is that only some of the sleepyWhispers messages are marked on the graphs. As we will discuss later, the log data shows that there were more sleepyWhispers messages exchanged than those reported in the contact diaries. Secondly, our participants only ever marked the receipt of an asynchronous message (email, sleepyWhispers, SMS), never the creation of it. This means that as substantial as our data set is, there are aspects of the messages which we do not have data on. However ,if both participants correctly reported all 'receives' the missing 'sends' are automatically included.

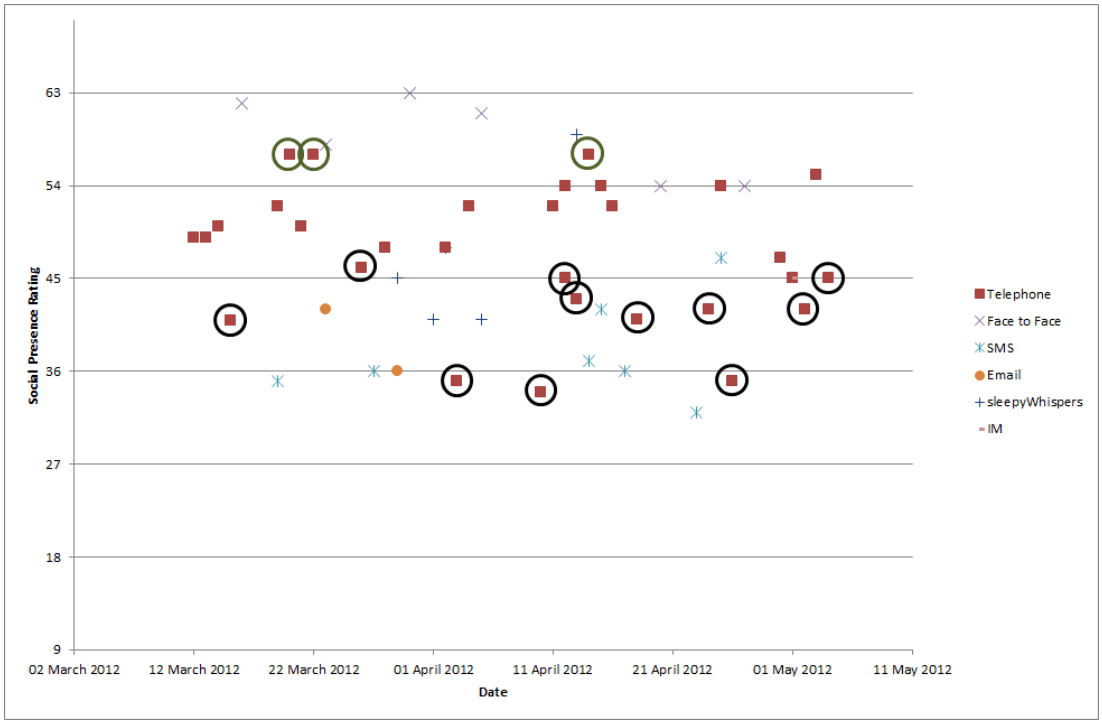


Figure 9.7: A graph showing pZ's SP data by Medium and time

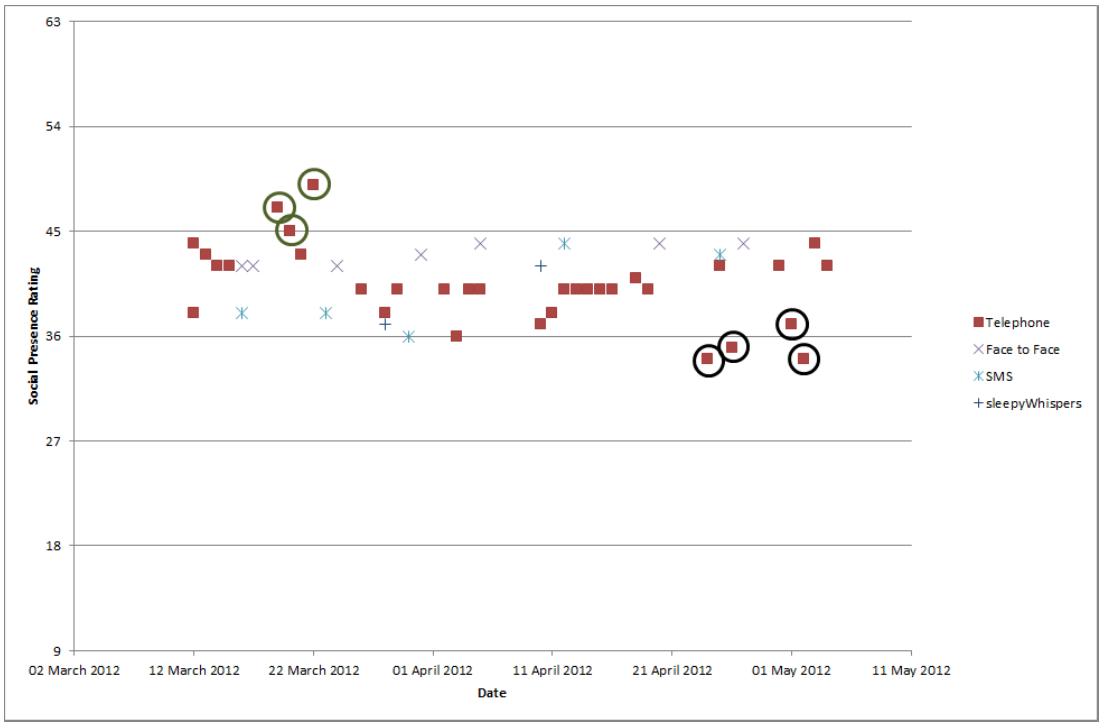


Figure 9.8: A graph showing pK's SP data by Medium and time

Anomalous SP Results

The literature (see Section 2.4) and our logbook study (see Chapter 4) both suggest that face-to-face and telephones should generally score higher SP scores than other media.

Looking at pZ's Social Presence graph (Figure 9.7), there are two notable groups – an anomalously low set of telephone scores (circled in black) and an anomalously high set of telephone scores (circled in green). pK's graph (Figure 9.8) also shows two anomalous groups of scores, the low scores circled in black, the high scores circled in green. These ratings were categorised post-hoc based on entries in the Contact Diary.

The diary entries for pZ's low scores indicated that such communicative acts are characterised by feelings of tiredness or other disturbances in the couple's routine. For example, on the 26th of March, pZ stated in her contact diary that she was "happy to speak but was a struggle towards the end as was quite tired".

Table 9.13 shows the descriptive results of comparing pZ's Social Presence scores by tiredness. The results indicate that these anomalous results have Social Presence scores which are lower than the other telephone call scores. This highlights how important the couple's routine is; any break in it, including tiredness, has a direct impact on the couple's Social Presence scores.

Tiredness	N	Mean Social Presence Score	Standard Deviation
Tired	11	40.82	4.09
Non-Tired	40	48.90	7.91

Table 9.13: Means of pZ's Social Presence scores by tiredness

Considering pK's sparse set of data points, we again find a pattern of negative emotional experiences – tiredness, pK venting frustrations, pZ seeming worried or distant. Table 9.14 shows the results of comparing pK's Social Presence scores by negative emotion.

Emotion Type	N	Mean Social Presence Score	Standard Deviation
Negative emotion	4	35.00	1.22
Non-Negative emotion	44	41.18	2.75

Table 9.14: Means of pK's Social Presence scores by negative emotion

These results indicate that although the routine may be of use to the couple, on evenings where one of the participants was tired, there was a detrimental impact on the individual's feeling of Social Presence.

The SP graphs also indicate a second set of anomalous results which are scored highly. The diary entries for these high scores indicate that such communicative acts are characterised by feelings of humour. No entry was categorised as being both humorous and tired. An example of a humorous act of communication for pZ occurred on the 20th of March where she was "happy because he [pK] made me laugh quite a lot".

Table 9.15 shows the results of comparing pZ's Social Presence scores by humour. The results highlight the importance of humour within the couple's relationship; a concept that we will return to in Section 9.4.2.

Humour	N	Mean Social Presence Score	Standard Deviation
Non-Humour	48	46.54	7.83
Humour	3	57.00	0.00

Table 9.15: Means of pZ's Social Presence scores by humour

Similar results can be seen on pK's graph. Table 9.16 shows the results of comparing pK's Social Presence scores by humour.

Humour	N	Mean Social Presence Score	Standard Deviation
Non-Humour	45	40.24	2.76
Humour	3	47.00	1.63

Table 9.16: Means of pK's Social Presence scores by humour

sleepyWhispers Routine

We've previously discussed what the couple's communication routine is. One of the aims of the case study was to investigate how sleepyWhispers might fit into that routine.

pK made it clear that sleepyWhispers didn't replace any acts of communication but was in compliment to their current behaviours:

"it was an added dimension... I think [it] complemented how we usually communicate... it didn't replace any aspect of how we would normally communicate i.e. we didn't txt each other less, or talk less on the phone" [pK - second interview]

"the message we sent on sleepyWhispers we wouldn't have normally shared" [pK - second interview]

We go on to discuss how these messages differed from the normal communication routine in Section 9.4.2.

pZ observed that sleepyWhispers didn't become fully integrated into the couple's communication routine. This occurred for two reasons. The first is that during the study, pZ was spending a lot of time travelling between Bath and her family home in Essex. As such, there were pragmatic reasons around only using the system at particular times.

The second reason is that the couple's routine is so strong, the couple have no time for investing effort elsewhere. This is exacerbated by the logistical effort it took to use the system (see Section 9.4.2). Given that our participants also knew that they wouldn't be able to keep using the system after the study, there was no incentive to try and integrate sleepyWhispers into their current routine.

"I guess because we normally communicate by talking, it didn't seem to fit in... the biggest problem we have is finding time to talk to each other... which is why we phone each other, we find it the easiest thing and I can do other stuff at the same time... as we talk to each other every night, it's just, finding the time to do that, anything we'd use would have to be easy and take as little effort as possible..." [pZ - second interview]

"when it's something you have to remember to check, whereas the phone demands that you answer it... sometimes, obviously if you got into the habit of doing it, it would be fine..." [pZ - second interview]

sleepyWhispers was generally used in the evening. The couple have a strong separation of their work/personal lives which has a clear impact on when the technology was used. There is no evidence either way regarding the fact that messages were sent at this time to be consistent with the underlying metaphor of the system.

"I guess it would be more in the evening, when I'd normally talk to him and be home... I don't tend to think about him much, unless I need to ask pK something... I'm just thinking about work and I'm thinking about what I'm doing during the day, so it's only really in the evening that I think about that more... so that's why I wouldn't think about sending a message during the day necessarily" [pZ - second interview]

Moving on from the couple's communication routine and how sleepyWhispers fitted into this routine, we now consider what our participants talked about during their conversations, how that made them feel and whether they felt appreciated enough. We then consider how this interacts with communication media and feelings of SP.

To summarise our findings regarding the importance of the couple's communication routine, we have found four main things. The first aspect to note is the importance of routinely exchanging 'the little things' such that the couple remain connected whilst remaining apart. Although their regular phone call covers their main activities, it is important to them to share as much as they can. Secondly, the couple reserve evenings for the majority of their relationally meaningful communication, primarily because of a strict division between work and social time. We have found that this routine may not be ideal as SP appears to be mediated by both tiredness (which could be worse in evenings) and humour. Finally we should note that the 'receiving' of a note is more salient than 'sending' a note and that this may have implications regarding the design of communication technologies for LDDRs.

Thus far we have discussed how our participants communicated and what this routine can tell us about their experiences of SP. We now move on to discuss what (if any) impact sleepyWhispers had on their communication experiences.

9.4.2 Routine of sleepyWhispers

Having discussed our participants 'normal' communication routine, and how sleepyWhispers fitted into that routine, it is now necessary to analyse more deeply how sleepyWhispers affected their relationship. In other words, did sleepyWhispers help support the distant couple and if so, why?

The starting place for this analysis is to consider how often (and when) messages were sent. Table 9.17 presents the system log data in the form of dates and times of when messages were sent by each participant. Considering the timings, there is a fairly clear pattern. Messages were sent regularly throughout the study period (26/03/2012 through to 22/04/2012) but in no great quantity. There is only one occasion (on the 05/04/2012) where a message is sent in reply to an early message. Both participants sent roughly the same number of messages showing that neither participant dominated the other in the sending of sleepyWhispers messages. The final thing to note is the time-stamp of the messages; predominantly at night (05/04/2012 being exceptional in that regard) and generally late at night, around the time our participants would be going to bed. This is indicative that our participants used the system in a way which is consistent with the underlying metaphor of the system, namely late-night whispers/goodnight messages.

pZ	**pK**
28/03/2012 at 21:13	
	29/03/2012 at 02:12
	29/03/2012 at 02:28
01/04/2012 at 23:01	
01/04/2012 at 23:01	
05/04/2012 at 13:16	
05/04/2012 at 13:16	
	05/04/2012 at 00:49
	11/04/2012 at 22:34
	11/04/2012 at 22:34
	11/04/2012 at 22:47
18/04/2012 at 18:49	
	20/04/2012 at 02:46
	20/04/2012 at 02:46

Table 9.17: Details of the sleepyWhispers messages sent

Having seen that sleepyWhispers was used on occasion, we should now consider the emotional experience of using the system, as measured using the SP scales. As we do not have the daily Closeness scores, it is not possible to determine whether the couple's feelings changed over the different phases of the study.

The first step is to investigate whether there is any difference between the different communication technologies our participants used.

Table 9.18 gives a breakdown of the SP scores, across all phases of the study, by Participant and Communication Media. This data helps to inform our analysis of the impact sleepyWhispers was having.

We can observe from this data one of the shortcomings in relying on diary data; although pZ records corresponding by email and IM, pK records no such acts of communication. Likewise,

Communication Media	pZ			pK		
	SP			SP		
	Mean	**SD**	**n**	**Mean**	**SD**	**n**
Telephone	47.70	6.41	30	40.38	3.27	34
Face to Face	58.67	3.64	6	43.00	0.93	7
SMS	37.86	4.64	7	39.80	3.12	5
Email	39.00	3.00	2	-	-	-
sleepyWhispers	46.80	6.65	5	39.50	2.50	2
IM	45.00	0.00	1	-	-	-
Total	47.16	7.98	51	40.67	3.16	48

Table 9.18: Breakdown of Social Presence scores by Participant and Communication Media

pZ and pK record having a different number of telephone conversations. There is little we can do to in terms of ensuring that diaries collect complete data as we discussed in Chapter 3.

Interestingly, the number of diary entries which report using sleepyWhispers does not correspond to the logs of the system (compare the n in Table 9.18 to the data in Table 9.17). This is particularly the case for pK. One interpretation of this is that pK chose to "group" his sleepyWhispers messages together with regards to reporting them in the diary. Another is that the missing diary entries are a trade-off from using diaries – we acknowledged early on that diary studies have a particular weakness with regards to collecting complete data (see Chapter 3).

Considering the results of Table 9.18, Face-to-Face communication is ranked highest in Social Presence by some way. This is unsurprising; a more remarkable result would be if some other communication technology out performed Face-to-Face. The next banding of results includes the Telephone and sleepyWhispers for both pZ and pK. Looking at the raw data we can see that pZ's sleepyWhispers scores is comparable to the scores for the Telephone. pK's results show a similar tendency.

From the Social Presence data, we are in a position to argue that sleepyWhispers supported similar levels of SP compared to synchronous communication media with regards to supporting the relationship. This is encouraging given that the goal of the system was to support distant relationships through engendering a sense of Social Presence. Before considering some of the specific design facets which helped to create this emotional connection, we must discuss our participants reflections on using sleepyWhispers and how it impacted their relationship. This analysis is derived from the interviews we conducted with the participants after using the system.

Humour in sleepyWhispers

The first point to highlight is the purpose for which our participants used sleepyWhispers. All of the messages that our participants sent were based around humour or personal idioms:

"I was just using it to leave silly messages" [pK - second interview]

"[I was using] it to be funny or amusing... we used it more for in-jokes and things" [pZ - second interview]

This does not trivialise the system at all. Humour is an important part of social relationships

and this couple in particular characterised themselves as not being 'lovey-dovey' but based more around humour.

"I can see us leaving jokey messages like more than soppy ones; we're just not that sort of couple really... but it's still nice, it's still an affectionate way, not in a mean way though sometimes pK says I'm sooo mean to me, you bully me..." [pZ - second interview]

"some people are more lovey-dovery, texting each other constantly, and I mean I hardly ever text pK... just because I can't be bothered... texting to me is a chore, I don't text people unless there's something specific I want to tell them, but some people text all the time..." [pZ - second interview]

The importance of humour is likewise reflected in the SP scores – referring back to Figures 9.7 and 9.8 we should again note that the anomalously high results were characterised by humorous content. The fact that sleepyWhispers was predominantly used to exchange humorous messages would go some way towards explaining it's high rankings of SP.

Hearing own voice in sleepyWhispers

One interesting point to discuss is the impact that voice had on our participants' perception of the system. pZ in particular had a visceral dislike of hearing her own voice:

"I hate the sound of my own voice... and you had to listen to yourself back to make sure you'd recorded the message right, I hated that process of it... and I don't know, just recording answer phone messages are horrible so I just didn't like... that's why I didn't really want you to listen to the messages, it's just cringe-worthy... so I didn't enjoy that experience of recording even, even though I enjoyed pK's messages, having to, and I'm sure he liked listening to mine, but because you can't just expect people to send you stuff and not send something back" [pZ - second interview]

This quote also illustrates the necessity of behaving in a reciprocal manner in order to maintain a balanced relationship. In addition to disliking hearing her own voice, pZ highlighted that within their relationship, our participants were more likely to write down meaningful things than they were to say them:

"I think generally, in our relationship, we'll write nice cards to each other but we wouldn't necessarily say it... so I think I feel more comfortable communicating certain things through text rather than saying it" [pZ - second interview]

This could be another contributing factor for using sleepyWhispers to send humorous rather than intimate messages. As we have argued before, the sensory medium the communication technology uses has a substantial impact on what messages are (and can be) sent.

Relationship Impact

We wanted to investigate what our participants thought the impact of using sleepyWhispers had been on their relationship. The first thing that we should note is that the participants recognised that sleepyWhispers was always unlikely to have a long-term impact on their relationship given the time frame they were using the system for compared to how long they had been in a relationship:

"it's quite a short time frame really... especially considering how long we've been together so it's like, no I don't think you can say it would have..." [pZ - second interview]

They did enjoy using sleepyWhispers given the humour aspect of it, something which they didn't do when using other communication media. This new channel of communication led to the couple communicating different types of content:

"probably be something that would solidify our relationship as we both enjoy joking around... a lot of the messages made me laugh" [pK - second interview]

"We wouldn't normally sing songs down the phone to each other so it was a different way, it wasn't just, it did introduce a different way of communicating rather than just chatting on the phone..." [pZ - second interview]

This resulted in a short-term benefit but the participants didn't feel like it led to a longer-term feeling of Closeness:

"I don't think it necessarily make us feel closer to each other [but would] keep things interesting" [pK - second interview]

"something a bit different but can't see it as something that i would use long term" [pK - second interview]

Without any Closeness data, this view is difficult to discuss although it does correspond with the high SP scores associated with sleepyWhispers.

Summary

In general then, we are in a position to argue that sleepyWhispers performed reasonably well compared to other synchronous voice-based communication media in terms of SP scores. This is more exceptional given the strength of the participants current routine and the logistical problems which they faced when using the system (see Section 9.4.3). We've discussed how our participants generally used sleepyWhispers for humorous reasons and how they believe it was pleasant to use but had little longer-term impact.

Our data shows that although used infrequently, sleepyWhispers was used for specific purposes which other communication media don't encourage. Additionally, when it was used, it did support moderate feelings of Social Presence – the exact purpose for which it was designed. We now move on to discuss the underlying design facets of sleepyWhispers and our participants' thoughts on these particular factors.

9.4.3 Design of sleepyWhispers

Thus far we have discussed our participant's communication habits and how sleepyWhispers impacted their relationship. The following section discusses specific design facets within the sleepyWhispers system and how these concepts affected our participants' experiences of using the device.

There are seven main areas to discuss, namely the pillow metaphor, fleetingness, one-to-one communication, asynchrony, serendipity, logistics and some redesign ideas. This ordering discusses the design facets in the order presented at the end of Chapter 6 before discussing other issues.

Pillow Metaphor

The pillow-talk metaphor behind sleepyWhispers resulted in the use of the pillow-based speakers. Our participants had different views about this; pZ didn't see any value in it:

"I didn't really use that part, just because of all the problems with setting it up... it was just easier to listen on my laptop whenever I got a chance." [pZ - second interview]

whereas pK enjoyed using it even if it didn't impact his view of the messages:

"I thought the pillow was a nice touch better than having a speaker although i don't know think it changed my opinion of the messages" [pK - second interview]

Instead, the value of the pillow was in the way that it blended into the participants room without the addition of any overt or bulky equipment:

"I thought the pillow was more non-evasive i.e. it went on my bed and I didn't really think much more about it. With a speaker I would probably need to move stuff around in my room to find a space for it etc. I suppose I would have a pillow in my room anyway and its discrete." [pK - second interview]

There's no evidence to suggest that the personal location of the speakers (namely the pillow) had a positive impact on how the participants regarded the messages.

Fleetingness

The sleepyWhispers system had a multi-faceted approach to fleetingness. The messages were listen-once by default, making them fleeting. However, there was an option to download each individual message, making them realised. The intention was to allow participants to retain messages which were special to them. What we had not considered was that the listen-once feature may have an impact upon the *sender* of messages as well as the receiver.

We have already discussed how pZ didn't like to listen back to her own recordings. The listen-once feature forced her to listen through them as she perceived a pressure to ensure that the messages were clear enough to be understood on the first listening:

"I found it a little bit 'Oh, I better make sure I can hear this' or 'I better make sure the sound is on' sort of otherwise I might not be able to hear it again... so it made me feel a little bit of pressure I guess, because if it was a good message or something you might miss out on it because of the technology I suppose..." [pZ - second interview]

Similar feelings of stress were felt by pZ when listening to the messages:

"if I didn't have the volume up high enough, or if someone else came in when you were listening to it and they started talking to you and you didn't hear it, then you might miss something really important that they were telling me so..." [pZ - second interview]

Conversely, pK found that "listening to the messages once was usually enough/adequate" [pK - second interview].

This was mainly down to the content of the messages. Being humour based, pK saw no need to keep them as they were not important to keep:

"they tended to be short messages probably not much longer than 30 seconds and there was nothing in the content of the message that was really worth keeping... so i suppose yes cause they were humour-based the messages weren't that meaningful... when i say not meaningful... i don't mean that i didn't enjoy the messages it just that the content of the messages didn't have any importance" [pK - second interview]

pZ wasn't aware of the download feature but on reflection said:

"I might have downloaded the ones where he sang a song, just because he put more effort into those ones and also they are still relevant days/weeks later, not like telling someone to do something and talking about something that happened the day before or whatever." [pZ - second interview]

which provides some indication that the download feature of sleepyWhispers was successful, even if the listen-once element was unsuccessful.

One-to-One

An additional design facet we are interested in is one-to-one communication. This factor describes who can communicate through the system (see Section 5.4 for full details). In order to investigate our participants' thoughts on this, they were directly asked whether they would have liked to have sent or received messages from anyone other than their partner.

pZ was very much against opening the system up; she was very keen on keeping it as a closed media with her partner:

"No, I don't think so; not by sending voice messages... I guess pK's the only person I wouldn't mind listening to my voice!" [pZ - second interview]

We have previously described how pZ was very keen on keeping the system private. There is a clear link here between keeping the system private and who can use the system. A closed system offers the ability to exchange intimate messages in private.

pK had an alternative view, particularly based around his friends:

"All I can picture is someone I know leaving some creepy message for me and probably not being able to sleep ever again after hearing..." [pK - second interview]

but with regards to family pK had a broader view:

"I can't imagine what sort of message family would leave... then again I suppose it could work for instance birthday messages. So I can see that it might be useful but it'll be something I would only use on special occasions maybe." [pK - second interview]

This indicates that openness is not a clear cut issue. Although pK was more amenable to using sleepyWhispers with people outside of the relationship, this was in particularly special circumstances. Similar to the findings of the design interviews (see Chapter 6), we have found evidence that questions of openness are not clear cut and have a contextual element to them. With that rider, it still seems that the default position of closed communication does help create the opportunity for exchanging intimate messages.

Asynchrony

Asynchrony is another of our design facets which was directly designed into the sleepyWhispers system. The ability to leave messages was appreciated by our participants:

"I suppose the only, one thing which is good about it is sometimes the phone wouldn't... we're not both available to talk at the same time so you could just leave a message... obviously to communicate you both have to be free to talk at the same time." [pZ - second interview]

The couple rely on the telephone as their main form of communication. We've previously discussed how their schedules don't always allow them to chat every night. Therefore an asynchronous communication system which utilises voice fits within their communication habits.

In addition to this practical element of the asynchrony, leaving messages rather than having a live link gave the couple the opportunity to communicate in a different way. As pK makes clear, the exchange of personal idioms and other humorous messages (which is what sleepyWhispers was mainly used for) is not something they would normally do over the phone:

"we sent silly messages to each other ... which we wouldn't normally say to each other because its a bit silly... you had the anonymity of the person not being then when you listened to the message so you were prepared to say sillier things than normal... for instance once i sang a song as a message but i would never sing to her on the phone" [pK - second interview]

As an additional benefit, the asynchronous aspect led to elements of excitement and anticipation when receiving individual messages, a concept which exists within our design space as 'serendipity':

"it was quite exciting when the message started playing, i suppose a bit like opening a present when you don't know what to expect... for instance if i saw i had a txt message from pZ i wouldn't necessarily get excited about it" [pK - second interview]

Serendipity

A similar issue was raised with regards to the challenges involved in listening to messages. Participants did not know when they had received a message:

"one of the things that didn't appeal was having to press the button on the frame for check for messages... i think being alert that you have message somehow would have been better - I would like the pillow to glow when i had a message" [pK - second interview]

"it didn't fit in to how I kind of normally do things... I think we ended up having to remind each other to listen... it was more prompting... or when I did check it, there was nothing there [laughs]" [pZ - second interview]

We have already discussed the strength of our participants' routine. This routine exacerbates the lack of notification. As checking for messages is not part of their routine, nor was it likely to become so (at least in the short-term), participants were unlikely to check for messages on a regular basis without some form of notice.

There is a straightforward solution to this; namely to add a notification to sleepyWhispers. This is a straightforward redesign which our participations requested – the glowing pillow mentioned by pK is a particularly engaging idea.

This issue pertains to the concept of serendipity which we have discussed as one of our design facets (see Section 6.4). Serendipity speaks to the unanticipated discovery of messages. sleepyWhispers was intended to be somewhat serendipitous in so far as listeners had to seek out a message when they thought to do so. Our participants' desire for some form of notification indicates that serendipity can only be successful if it fits within an existing routine or if the messages need not be accessed through an interface (as with the MSD).

Logistics and usability

The issue of logistics is one which our participants mentioned many times. The major issue is with the equipment that makes up the sleepyWhispers system being too cumbersome to set up and use.

Our participants were aware that they were using a prototype design. Despite this they continued to highlight the logistical issues with the current design of sleepyWhispers indicating that these were severe concerns:

"I suppose one of the things was i found it was an effort to send a message..." [pK - second interview]

"it was just a bit of a faff really... like, I don't know... it was too much work for it to be something I would use to communicate... in an ideal world, [where] it was all done through the photo frame it would be different" [pZ - second interview]

There were two key redesign recommendations our participants suggested. The first was to remove all the wires within the system, the second to remove the laptop aspect and use the photo frame to control the recording and listening of messages.

The significance of this goes beyond the refinement of this particular design. Given how effortful our participants found using the system to be, we need to interpret the results of this case study in that context. This was not effort which our participants appreciated; it was effort which prevented them from perhaps using the system more often.

The difficulty of sending a message had a side-effect of increasing the feeling of appreciation when receiving a message given the effort involved in sending said message:

"in a way, you know how much effort it was to do, if someone else has done that for you, then you do appreciate that they've made that effort, made the effort to send it... I guess that means you'd appreciate the message more than if it was easy..." [pZ - second interview]

This appreciation/effort trade-off is rather different from the effort factor we have previously described in the design space (see Section 5.4). The logistical effort is meaningless to the sender rather than meaningful creative effort, making it less appealing than the effort invested into, for example, the creation of MSD notes (see Chapter 7).

Redesign Options

pZ had some specific ideas as to how to redesign sleepyWhispers. The first was to ensure that the system was a completely closed unit; that messages were both recorded and sent through the photo frame, increasing the security of the messages:

"I guess one issue is if you record it, there's a potential other people could listen to it... obviously at pKs end, you don't know, you don't have any control, you've sent this thing out there and now it's... so then that would make you think about what you've recorded" [pZ - second interview]

This is an expression of pZ's concern that messages might 'escape' and that people other than pK may listen to them. This reflects a desire to retain the one-to-one communication aspect of the system. It also relates to concerns we noted in Chapter 6 around 'channel abuse' where people think they are communicating with their partner but are actually communicating with someone else.

The other area for redesign was the focus the system more around the photo frame rather than the pillow. This would offer the opportunity to share images on the frame as well as sound clips:

"what would be nice is a digital photo frame and you could attach an image to the sound... I guess you see something, like a 'I saw this and thought of you' but with you actually saying it... would be nicer than just texting it... or you could, send some music or something associated with it, not necessarily something you'd recorded yourself... I think that would be good with the digital photo frame..." [pZ - second interview]

The interpretation of this is based around wanting to combine different types of media to lessen the necessity of recording pZ's own voice. This is something which we previously noted impacted pZ's feelings towards the system. The inclusion of 'sensory medium' within the design space is also supported by this view where different sense are best used to communicate certain types of information – in this case, utilising both sound and images to create a more emotional connection between partners.

9.4.4 Discussion and Conclusion

The consistent theme which runs through all of our results is the strength of the couple's communication routine. pZ argued that they have a routine which works and that this is why they won't experiment with other technologies, even if they are perceived as being potentially 'better':

"we haven't started using Skype either, now pK's got a computer, we could start using it but this is just what we do... and that works..." [pZ - second interview]

This demonstrates a level of conservatism with regards to making changes to the routine. The routine is not only a habit; it is something which connects the couple and as such has a high-level of value within the relationship.

The strength of the routine has consequences for this study. Given how long the routine has been in use, and the comparatively short amount of time sleepyWhispers was installed for, it was unlikely to make a substantial impact on the couple's behaviour, something pZ herself indicated:

"it's quite a short time frame really... especially considering how long we've been together" [pZ - second interview]

The comparatively short time sleepyWhispers was installed for highlights the difficulty of getting meaningful results or making an impact on a couples' feelings of SP. A month of using a new

technology cannot compare to a four and a half year routine of using other media. This is not to devalue this case-study; nor are we suggesting that case-studies of this type need to be undertaken for longer periods of time. We are instead arguing that meaningful data and results *can* be gathered from a medium-term case-study such as ours. However, we should not forget that our findings are limited by this consideration.

One of the more striking findings from our data was the visceral dislike to hearing her own voice that pZ described when recording messages for sleepyWhispers. Voice messages are somewhat unique in that once recorded, they are very difficult to edit. In comparison, live links (e.g. phone calls) allow speakers to clarify their comments on the fly to achieve comprehension, both typed and handwritten text messages are straightforward to edit (crossing out words or deleting and retyping). Similarly, drawn messages (such as with doodleMessenger and the Magic Sock Drawer) can be easily edited. Phatic-links (such as with hotMitts, hotHands, hotHugs and yourGloves) have no message which needs to be edited.

Recorded voice messages are not often used for personal relationships which was one of the starting points of the sleepyWhispers design. Although creating the messages is relatively straightforward (software to record .mp3 messages is freely available), editing those messages is an activity that most people will be neither familiar nor comfortable with.

This unfamiliarity caused a certain amount of anxiety in our participants, something which undoubtedly negatively impacted their feelings regarding the system and how often they would use it, seeing it more of a chore than something to look forward to.

There are two possible solutions to overcome this issue. The first is to create a sound editing program that our participants could use easily (or train them to use an existing one). Although feasible, this would involve a level of investment which potential users are unlikely to make in order to use an unproven communication technology. The second solution is to somehow engender a sense of trust in the recording process such that participants do not feel the need to listen to messages they have recorded. Exactly how this could be done is unclear.

The anxiety which surrounded the recording of messages was further exacerbated by the fleetingness of the messages. pZ heavily disliked listening back to her own voice but felt she had to listen back to them in order to ensure that the message was clear as pK could only listen to each message once.

The anxiety experienced by pZ when recording her messages for pK highlights how fleetingness alone is not enough to engender a sense of Social Presence – it has got to be coupled with the correct media/message. This didn't occur with sleepyWhispers; if anything, our data indicates that fleetingness can have a negative impact.

We should also note that although our participants generally discussed the experience of both sending and receiving of messages, they only recorded the receiving of messages within their diaries. This appears to be the case for other asynchronous messages such as SMS and email messages, based on the number of each type of message recorded by each participant. There are two complementary explanations as to why this could be the case. The first focuses on the effort of completing the diary; our participants could simply have decided that by completing the receiving, and not the creation, of messages they would reduce the workload associated with the diary. The second explanation focusses on what part of the exchange of messages is most salient; our case study seems to suggest that participants are more engaged with the

process of receiving a message, hence deciding to only record those messages in the diary. The implication in relational terms is that although participants may reflect on their partner when generating a message, the receiving of a message is more emotionally meaningful. This argues in favour of having a symmetric reciprocal communication system such that both partner's are receiving messages which assist them in feeling emotionally connected.

This case study has found that sleepyWhispers was associated with levels of Social Presence akin to the couple's use of the telephone, partially answering RQ3. The study has also explored our participant's views with regards to some of the design concerns built into sleepyWhispers, strengthening our answer to RQ2. We found that some design concerns (namely idiomatic messages, asynchrony, openness and metaphor) were appreciated, some (fleeting versus realised, sensory medium, serendipity) were disliked and some (metaphor, effort) were more complicated. In Chapter 10 we shall combine these findings with the results of the other four case studies in order to discuss how they assist us in answering our two primary research questions, RQ2 and RQ3.

9.5 Tangible Systems

Finally we turn our attention to the two tangible systems, hotHugs and hotMitts.

In terms of our hotHugs participants, pLu recorded 80 acts of communication, pAl 76. We additionally have the data from the Daily Diaries and the interview transcripts.

In terms of our hotMitts participants, pM recorded 70 acts of communication, pT 82. We additionally have the data from the Daily Diaries and the interview transcripts.

We begin our analysis by discussing the first of our interesting questions: how do our case study participants communicate and how did hotHugs or hotMitts fit into that pattern?

9.5.1 Routine/Communication Ecology

The hotHugs couple had a well defined communication routine when they were a co-located couple, "we'd see each other at school and outside of school, texting, msn, skype (mainly during exam time)" [pAl - first interview]

SMS and MSN were used because they were quick and easy to use and were primarily used for exchanging information or making plans. Face to face was considered best for intimacy and closeness whilst Skype was used when they couldn't see each other because of exams. This was considered to be "not as personal" [pLu - first interview] as seeing each other.

Similarly, the hotMitts couple had a very clear routine before moving apart; they would mostly see one another face-to-face as this was the most emotionally meaningful way of being together. SMS and IM were convenient and quick so allowed a sense of connection even during the busy exam period.

When the hotHugs couple moved apart, their communication routine changed:

"we usually text during the day, and then phone in the evening or Skype" [pAl - first interview]

The couple's texts are imbued with more meaning than when they were co-located, being used to stay involved in each other's lives rather than exchanging information:

"we probably tell each other more in texts now and text more because we don't see each other like we used to" [pAl - first interview]

In general, their technology use has become more of a trade-off between convenience and connectedness:

"we phone more on mobiles because it is more convenient if we want a quick call (no switching on computer faff), but Skype is better for if we're feeling distant as it is definitely more personal" [pLu - first interview]

The hotHugs couple's use of Skype was something carried over from their co-located routine and was used for much the same purpose. The couple manage to visit each other "usually every 2/3 weeks for either between 2-5 days" [pAl - first interview], with pAl doing much of the travelling due to him being on a gap year, although pLu goes home during the holidays.

"I saw my partner today for the first time in a few weeks and I am feeling the most close I have done since last seeing him" [pLu - contact diary]

"was the best feeling ever seeing her come off the train, couldn't have felt any more excited and in love if I tried" [pAl - contact diary]

Since moving apart, the hotMitts couple have also changed their routine dramatically; pT has started to overcome her shyness with regards to phone calls:

"I'm quite shy when it comes to phone calls, its only really since pM has been away that I've got used to talking on the phone" [pT - first interview]

This means that they try and use Skype (with video) as much as they can

"We try and make sure we use Skype as much as possible, so we can actually see each other" [pM - first interview]

They use Skype with video as it "makes it slightly easier" [pT - first interview] Being able to see each other on Skype is the closest the couple can achieve to being together using current communication technologies.

One of the main difficulties the hotMitts couple find in using Skype is that, being synchronous, it is difficult to schedule around their daily lives:

"we've really had to make time for it, which is very difficult, almost making schedules round college and uni" [pT - first interview]

"Been difficult to Skype today as I have been dancing for two hours" [pT - daily diary]

The onus on being together falls upon pM; given that pT still lives in their shared home town, he travels back usually every 2-3 weeks for the weekend and also spends his holidays there. Spontaneously arriving unexpectedly early was particularly appreciated by pT:

"pM was due to come home tomorrow for my Birthday but surprised me by turning up at my dance lesson tonight! So happy right now!" [pT - daily diary]

"[he] turned up several hours early in the bus station that the college bus goes to. It's moments like that that make the distance worth it!" [pT - daily diary]

This suggests that a communication system which doesn't require scheduling and allows spontaneity (i.e. an asynchronous system) could help the couple's relationship.

The hotHugs couple believe that their relationship has developed as a result of the distance, that the challenge of being apart has strengthened their relationship.

"I think now our relationship feels stronger, even though we've had harder times since being apart... feels more committed" [pLu - first interview]

"you have to just trust them fully because you don't know what they're doing apart from them telling you" [pAl - first interview]

Our hotHugs participants also thought that their communication technologies had assumed a new meaning within their relationship given the limited opportunities for face-to-face communication.

"being apart makes them more meaningful than when you're together, as when you're together you can just tell each other face to face the things you'd usually text" [pAl - first interview]

"I think it means more now as when we're apart it feels more distanced so when there is communication it feels more like it has an impact" [pLu - first interview]

The hotMitts couple also discussed how communication technologies have assumed a new significance in their relationship as they are the only means available to sustain it. This includes both positive and negative aspects of the relationship:

"if I'm upset or stressed he isn't physically there which is frustrating when normally he could hug me... I think we tell each other more personal things... because we have to for it to work" (pT)

This was particularly true of face-to-face encounters which help reassure the couple that their relationship could survive being a long-distance relationship:

"Just proof that the distance won't stop us" [pT - contact diary]

The daily diaries highlighted how the couple (and in particular pT) had particular issues with dealing with the distance aspect of their relationship. She struggled in particular to deal with missing pM (particularly when he was leaving home to go back to University) and to reconcile herself with feelings of being isolated from pM's day-to-day life:

"Been feeling very ill and therefore missing pM being here because all I want is a cuddle" [pT - daily diary]

"He went back to Uni today, it doesn't hurt any less" [pT - daily diary]

"Feeling completely left out and ignored. pM went to sign a house contract with his friends and then later stayed with them instead of talking to me. Feel like I'm not part of his life at University" [pT - daily diary]

The overall picture painted by the hot Hugs couple during the interviews indicated that their routine is relatively settled and that they utilise the full range of communication technologies available to them to remain connected.

In contrast, the overall picture painted by the hotMitts couple during the interviews indicated that despite having a settled routine of using particular technologies for a clear reason, the couple were struggling with the lack of face-to-face communication and that their relationship was suffering as a consequence.

The hotHugs couple's self-description of their communication routine is corroborated by the data reported in the couple's Contact Diaries, as can be seen in Figures 9.9 and 9.10. The hotMitts couple's self-description of their communication routine is corroborated by the data reported in the couple's Contact Diaries, as can be seen in Figures 9.11 and 9.12.

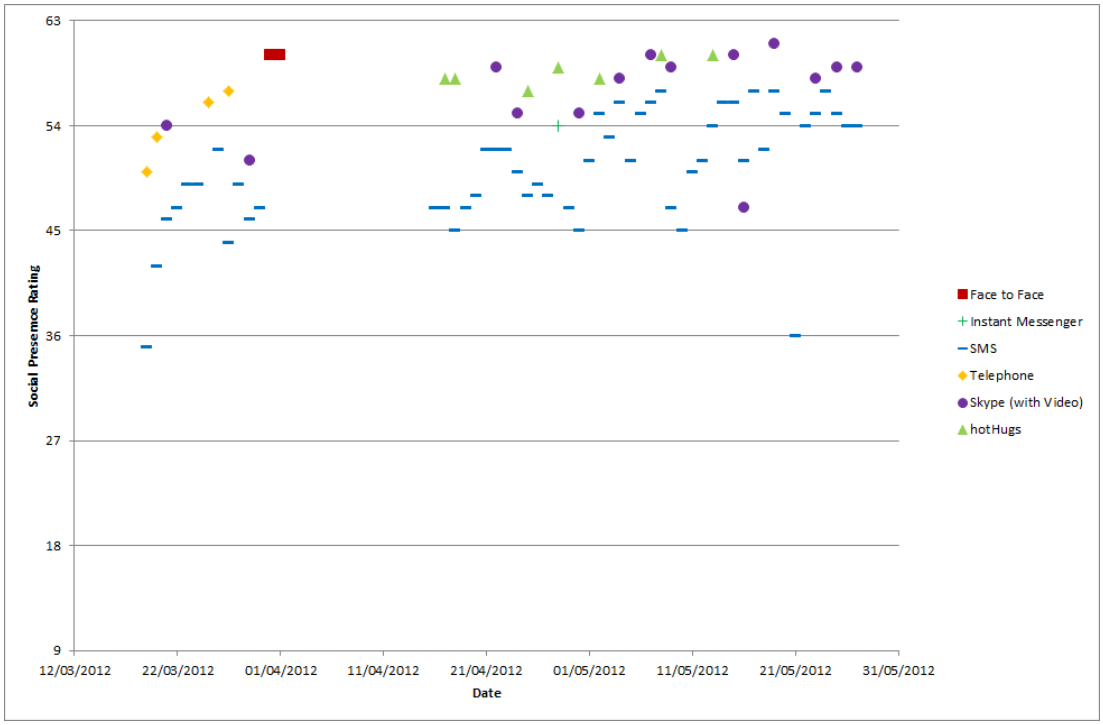


Figure 9.9: A graph showing pLu's SP data by Medium and time

Anomalous Results

The hotHugs graphs indicate no anomalous results which need further analysis.

In terms of the hotMitts participants, the two graphs show both participant's Social Presence scores across time. Each of these graphs have a set of anomalously low data points; the majority of these results are shared across both graphs (namely those communication acts occurring on 23/03/2012, 31/03/2012, 19/04/2012, 22/04/2012 and 03/05/2012). Each of these acts involved some form of argument according to Contact Diary entries. For example, pT reports in her Daily Diary on the 23rd March that "unfortunately we argued before about plans for his birthday so not spoken much on Skype. Very short answers to forced questions, lots of silence".

The additional data points did not involve arguments but did express emotional distress (pM was missing pT, see the SP score on 29/03/2012 and pT thought pM wasn't listening, see the SP score on 21/04/2012).

Table 9.19 shows the results of comparing pM's Social Presence scores by whether the couple were arguing or not.

Table 9.20 shows the results of comparing pT's Social Presence scores by argument.

What these tests indicate is that communication acts involving an argument have Social Presence scores which are significantly lower than other acts of communication. This is an important

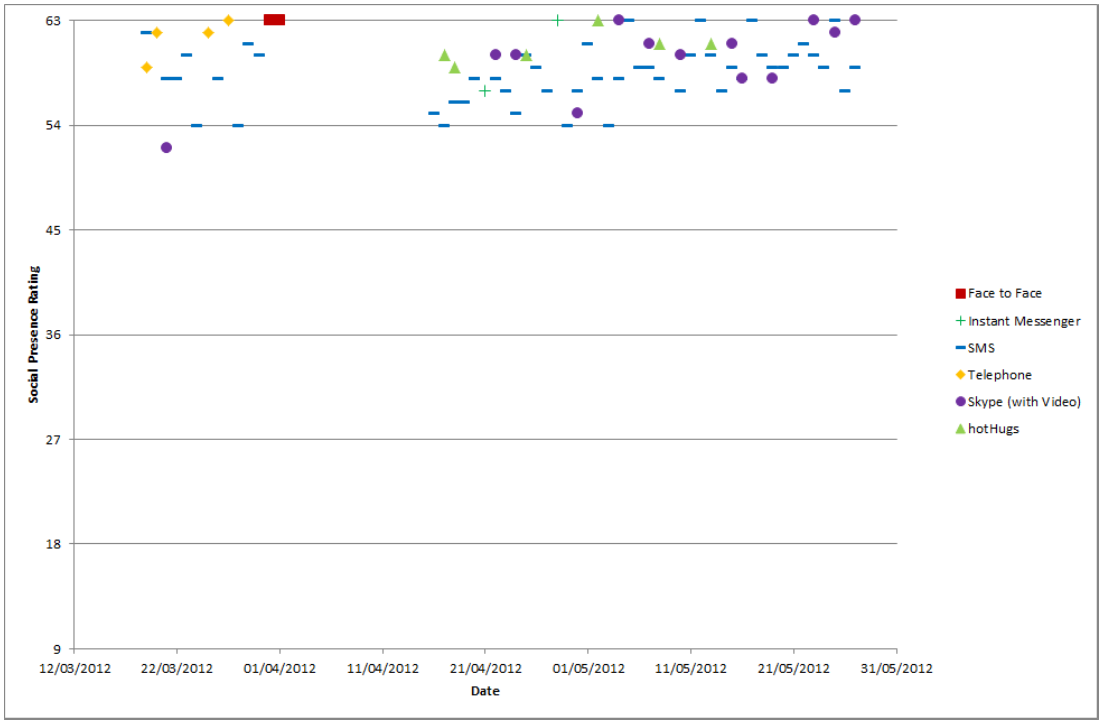


Figure 9.10: A graph showing pAll's SP data by Medium and time

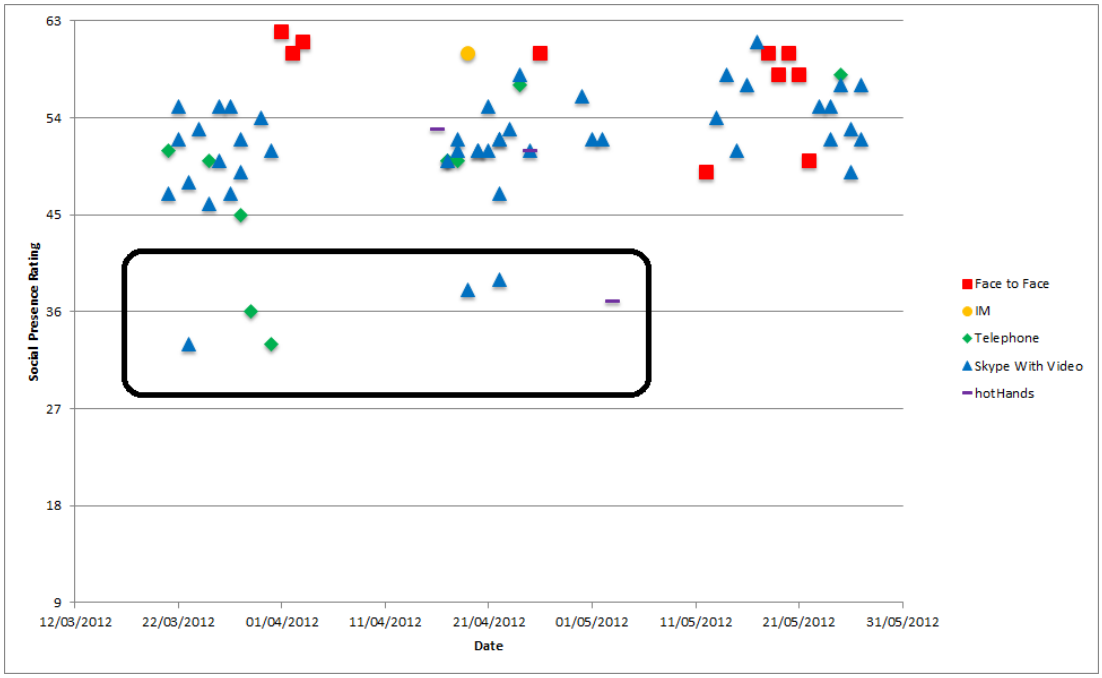


Figure 9.11: A graph showing pM's SP data by Medium and time

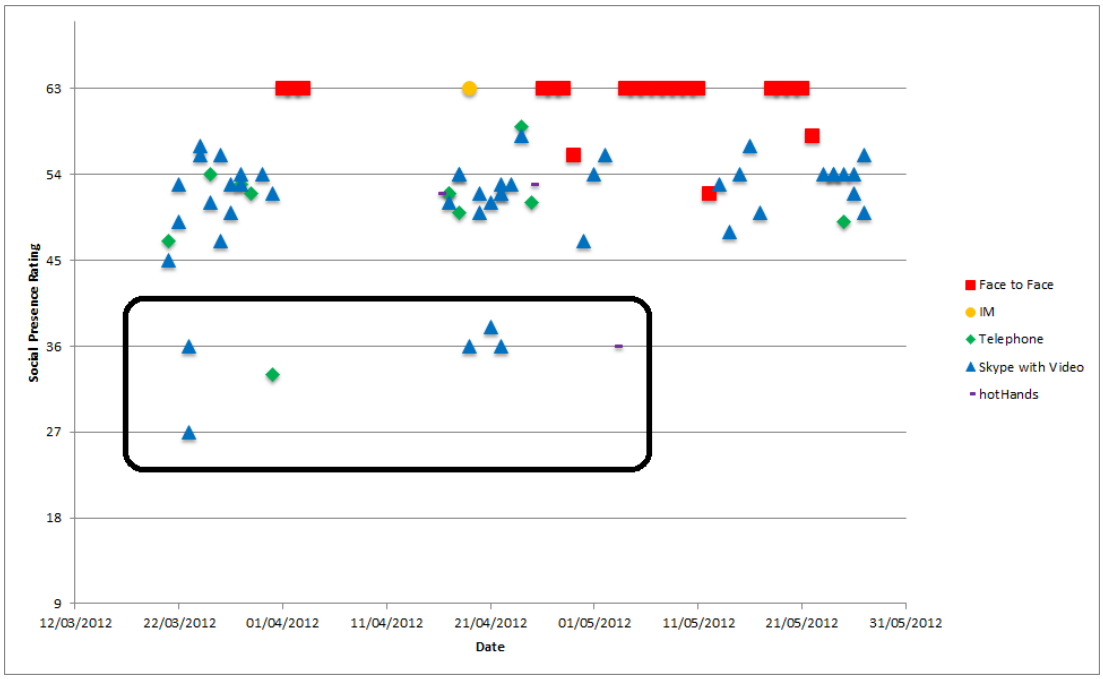


Figure 9.12: A graph showing pT's SP data by Medium and time

Conversation Type	N	Mean Social Presence Score	Standard Deviation
Non-Argument	64	53.31	4.10
Argument	6	36.00	2.31

Table 9.19: Means of pM's Social Presence scores by argument

Conversation Type	N	Mean Social Presence Score	Standard Deviation
Non-Argument	75	55.25	5.12
Argument	7	34.57	3.37

Table 9.20: Means of pT's Social Presence scores by argument

point which we will discuss further later on.

hotHugs Routine

HotHugs fitted in well with the couple's routine. Overall, it was felt to be a useful technology which helped to connect the couple:

"today we used hotHugs and I'm feeling very close to my partner now" [pLu - contact diary]

"really good today, we hotHugged it which was nice. It's nice being able to send little hugs!" [pAl - contact diary]

HotHugs fitted in well with the couple's Skype routine which focussed around being connected:

"we just used it whenever we had the time really, usually in the evenings before bed" [pLu - second interview]

"we had a long call on Skype using hotHugs. This has left me feeling good and positive about the future" [pLu - contact diary]

To summarise our findings regarding the importance of the couple's communication routine, we have found three main things. The first aspect to note is the clear division between using scheduled synchronous communication media for emotionally rich conversations and using asynchronous messaging technologies to remain connected in a lightweight way throughout the day. Secondly hotHugs was used in conjunction with technologies the couple already used. This is potentially beneficial as it means that hotHugs was easily integrated into the couple's communication routine. Finally, the couple clearly stated that they felt that their use of communication technologies had become more relationally meaningful since becoming a long distance couple.

hotMitts Routine

hotMitts appeared to fit well into the couple's existing communication routine because the devices were used to augment their Skype conversations. Our participants found that using the hotMitts on their own (or with other technologies such as IM) were somewhat weird:

"it seemed a bit weird to use just the hands" [pM - second interview]

"I think being able to see the other person really helps with it" [pM - second interview]

Realism seemed to be one of the defining qualities of this weirdness; pT specifically stated that when holding hands normally "you tend to be talking or at least be able to see each other". Thus their use of hotMitts fitted in with both the couple's existing routine and expectations derived from the hand-holding metaphor.

The participants also had a clear routine as to when the hotMitts were used:

"if we were feeling a bit separated or missing each other a lot that we got them out" [pM - second interview]

"We'd tried to use them cause we had argued and were trying to make up" [pT - daily diary]

"we used them because we had argued and we were trying to get closer again" [pM - daily diary]

The devices were overwhelmingly used when the couple had argued (or were missing each other) and wanted to make up or feel closer to one another. We have previously discussed how many acts of intimacy involve physical interaction and touch (see Chapter 2). It is perhaps no surprise then that the tangible technology of hotMitts was used when these acts of intimacy were needed most; to help repair the state of the relationship.

Moving on from the couple's communication routine and how hotHugs and hotMitts fitted into this routine, we now consider how this interacts with the communication media they were using and the feelings of SP and Closeness that they were experiencing.

9.5.2 Routine of hotHugs

Having discussed our participants 'normal' communication routine, and how hotHugs and hot-Mitts fitted into that routine, it is now necessary to analyse more deeply how hotHugsaffected their relationship. In other words, did hotHugs help support the distant couple and if so, why?

The starting place for this analysis is too consider how often (and when) messages were sent. Table 9.21 presents the dates and durations of when our participants used the hotHugs devices. The logs correspond to the data we collected from the diaries (see Figures 9.9 and 9.10). The dates indicate that hotHugs was used throughout the study period, typically in the evening for a few hours. This indicates that the hotHugs devices were liked and valued within the couple's relationship.

Date and duration of hotHugs use
28/03/2012 at 08:15 until 09:17
28/03/2012 at 11:43 until 12:22
17/04/2012 at 21:29 until 23:21
25/04/2012 at 21:06 until 22:47
28/04/2012 at 21:31 until 23:43
02/05/2012 at 21:34 until 23:36
08/05/2012 at 22:26 until 22:36
09/05/2012 at 00:25 until 00:28
13/05/2012 at 21:39 until 22:05

Table 9.21: Details of the hotHugs messages sent

Having discussed our interpretation of the usage data, we should now consider the emotional experience of using the system, as measured using the Social Presence and Daily Closeness scales.

The first step is to investigate whether there is any significant difference between the stages of the study (pre-use, during-use and post-use of the hotHugs system). Table 9.22 shows the results of comparing pLu's daily Closeness scores by study phase. There appears to be a difference between the SP ratings for each study stage.

Study Phase	N	Mean Closeness Score	Standard Deviation
Pre-	14	5.71	1.03
During-	28	6.50	0.68
Post-	14	6.64	0.61

Table 9.22: Means of pLu's Daily Closeness scores for each phase of the study

Table 9.23 shows the results of running a Kruskall-Wallis test on pAl's daily Closeness scores by study phase. There appears to be no difference between the SP ratings for each study stage.

There is no evidence to suggest that hotHugs has enough of an impact to change pAl's feelings of Closeness towards pLu. This could be due to his depression which we mentioned at the beginning of this Chapter.

There are three interpretations as to why pLu's data shows a difference across the three phases of the study. The first interpretation is that hotHugs had an impact on the couple's relationship

Study Phase	N	Mean Closeness Score	Standard Deviation
Pre-	14	6.29	0.45
During-	28	6.14	0.44
Post-	14	6.29	0.45

Table 9.23: Means of pAl's Daily Closeness scores for each phase of the study

and that this impact continued after using the software. The second interpretation is that reflecting on the relationship (through completing the diaries) had an impact on how pLu thought about their relationship. The final interpretation is that the difference reflects a deepening of the couple's relationship. As their relationship is a relatively new one which is still forming, the difference in Closeness could be an artefact from the development of their relationship. We believe a combination of these factors is likely to cause the difference.

We now move on to discuss the Social Presence scores on a per-communication media basis.

Table 9.24 gives a breakdown of the Social Presence scores, across all phases of the study, by Participant and Communication Media. This raw data helps to inform our analysis of the impact hotHugs was having.

Communication Media	**pLu**			**pAl**		
	SP			**SP**		
	Mean	**SD**	**n**	**Mean**	**SD**	**n**
Face to Face	60.00	0.00	2	63.00	0.00	2
hotHugs	58.57	1.13	7	60.67	1.37	6
Skype with Video	56.79	3.96	14	59.69	3.28	13
Telephone	54.00	3.16	4	61.50	1.73	4
IM	54.00	-	1	60.00	4.24	2
SMS	50.25	4.98	52	58.43	2.44	49
Total	52.60	5.52	80	59.14	2.70	76

Table 9.24: Breakdown of Social Presence scores by Participant and Communication Media for all data

Face-to-Face communication is ranked highest in terms of Social Presence. The next banding consists of hotHugs and Skype (with video). This is particularly understandable given that hotHugs was typically used alongside Skype. It is worth noting that both the statistical analysis and the raw data indicate that the addition of hotHugs increased feelings of Social Presence during Skype calls. The next banding consists of the telephone and IM, with the lowest banding consisting of SMS.

Given that hotHugs was designed to support distance relationships through creating the opportunity to share communication acts with high Social Presence, this result is positive given that it indicates that hotHugs achieves this aim. Before discussing how the design facets built into the software helps to create these high levels of SP, we first turn our attention to the interview data we have collected to better understand how our participant's used hotHugs and the impact the devices had on their relationship.

Forming Connections

Taking a broad view of hotHugs, our participants definitely saw value in using the hotHugs system.

"definitely a really good idea and worth having if you're in a long-distance relationship" [pAl - second interview]

Whilst using the hug belts, the couple stated that they did feel closer together.

"in the moment it did give a feeling of closeness, I think it was just nice to be sharing something" [pLu - second interview]

"in the moment it gave the feeling of closeness" [pAl - second interview]

However, the couple also doubted as to whether using hotHugs would have any longer-term impact on their relationship.

"I don't think it's really affected our relationship at all because we're pretty damn close all the time" [pAl - second interview]

"it was nice to use at the time but I don't think it had a big enough effect to completely change our relationship" [pLu - second interview]

Having said that, the couple did state that they would continue using a version of hotHugs if it became more integrated into their existing routine, specifically if it interfaced with Facetime.

"I think I would continue to use an adapted version of hotHugs like we discussed, but as it is using facetime has made a really big difference to us and if it couldn't be used with that then I don't think we would really make much use of it" [pLu - second interview]

Having discussed how hotHugs had an impact on our participants' relationship, we now move on to discuss the underlying design facets of hotHugs and our participants' thoughts on these particular factors.

9.5.3 Routine of hotMitts

Having discussed the SP results of hotHugs, let us analyse more deeply how hotMitts affected our case study participants' relationship. In other words, did hotMitts help support the distant couple and if so, why?

The starting place for this analysis is too consider how often (and when) messages were sent. Table 9.25 presents the dates and durations of when our participants were using the hotMitts devices. The logs correspond to the data we collected from the diaries (see Figures 9.11 and 9.12). These dates correspond to communicative acts intended to help repair the relationship after an argument.

Having seen that hotMitts was used for very specific purposes, we should now consider the emotional experience of using the system, as measured using the Social Presence and Daily Closeness scales.

The first step is to investigate whether there is any difference between the stages of the study (pre-use, during-use and post-use of the hotMitts system). Table 9.26 shows the results of

Date and duration of hotMitts use
16/04/2012 at 13:44 until 13:55
16/04/2012 at 19:44 until 20:05
18/04/2012 at 21:03 until 21:11
25/04/2012 at 21:40 until 21:47
03/05/2012 at 19:06 until 16:26

Table 9.25: Details of the hotMitts messages sent

Study Phase	N	Mean Closeness Score	Standard Deviation
Pre-	14	5.65	1.20
During-	28	5.38	0.99
Post-	14	5.83	0.76

Table 9.26: Means of pM's Closeness scores for each phase of the study

comparing pM's Daily Closeness scores by study phase. There appears to be no difference between the Closeness ratings for each study stage.

Table 9.27 shows the results of comparing pT's Daily Closeness scores by study phase. There appears to be no difference between the Closeness ratings for each study stage.

Study Phase	N	Mean Closeness Score	Standard Deviation
Pre-	14	4.92	1.53
During-	28	5.45	1.26
Post-	14	5.61	0.95

Table 9.27: Means of pT's Closeness scores for each phase of the study

There appears to be no difference in Closeness between which phase of study the participants were in. We have no evidence to suggest that hotMitts had enough of an impact to change our participants' feelings of Closeness against their normal communication routine.

The next step is to investigate whether there is any significant difference between the different communication technologies our participants used.

Table 9.28 gives a breakdown of the SP and Closeness scores, across all phases of the study, by Participant and Communication Media. Tables 9.29 and 9.30 shows the data for arguments only and the full data set without the argument data. This raw data helps to inform our analysis of the impact hotMitts was having.

Considering the data, Face-to-Face communication is ranked highest in Social Presence. The next banding consists of Skype (with video) with the lowest banding (which is still reasonably highly ranked) consists of the telephone and hotMitts.

We need to interpret this data given the knowledge that hotMitts was used to help repair the relationship after arguments. Given this use, we would not expect the device to be ranked highly. The telephone is ranked lowly in argumentative situations, as is Skype (see Table 9.29). This is in stark contrast to the non-argumentative data (see Table 9.30). Despite hotMitts

Communication Media	pM			pT		
	SP			SP		
	Mean	SD	n	Mean	SD	n
IM	60.00	0.00	1	63.00	0.00	1
Face to Face	57.80	4.30	10	61.90	2.84	21
Skype with Video	51.50	5.07	46	50.65	6.34	46
Telephone	48.00	7.64	10	50.18	6.16	11
hotMitts	47.00	7.12	3	47.00	7.79	3
Total	51.83	6.27	70	53.49	7.66	82

Table 9.28: Breakdown of SP scores by Participant and Communication Media for all data

Communication Media	pM			pT		
	SP			SP		
	Mean	SD	n	Mean	SD	n
hotMitts	37.00	0.00	1	36.00	0.00	1
Skype with Video	36.67	2.62	3	34.60	3.90	5
Telephone	34.50	1.50	2	33.00	0.00	1
Face to Face	-	-	-	-	-	-
IM	-	-	-	-	-	-
Total	36.00	2.31	6	34.57	3.37	7

Table 9.29: Breakdown of SP scores by Participant and Communication Media for the argument only data

Communication Media	pM			pT		
	SP			SP		
	Mean	SD	n	Mean	SD	n
IM	60.00	0.00	1	63.00	0.00	1
Face to Face	57.80	4.31	10	61.90	2.84	21
Skype with Video	52.53	3.26	43	52.61	2.83	41
hotMitts	52.00	1.00	2	52.50	0.50	2
Telephone	51.38	3.94	8	51.90	3.05	10
Total	53.31	4.10	64	55.25	5.16	75

Table 9.30: Breakdown of SP score by Participant and Communication Media for the non-argument data

being in the lowest banding of ranks, it is notable that *none* of the technologies were ranked particularly lowly (for example, compare against the mean SP score for SMS and email from the sleepyWhispers study (Section 9.4.2)).

From the SP and Closeness data we are in a position to argue that hotMitts performed reasonably well compared to other communication technologies, especially given the very specific purpose for which it was used. Although not associated with the highest levels of Social Presence, the hotMitts helped to support the couple's relationship by assisting them in relational repair.

Thus far we have discussed the impact of hotMitts in terms of Social Presence and Closeness scores. We now turn our attention to the interview data we have collected to better understand

how our participants used the hotMitts, the logistical issues they had with the devices and the impact the hotMitts had on their relationship.

Logistical Set-Up

Using the hotHand devices was not seamless which is unsurprising given the prototype nature of the devices. The initial set-up of the devices was not easy; technical problems meant that the system didn't work properly for around a week. Due to the sensitivity of the touch sensors, the device software was adapted. Originally the peltier devices only warmed up while the person's partner was touching the device. This was changed such that the heat occurred for three minutes from the partner's first touch. This overcame the original technical issues. Getting the hands out for subsequent use was also effortful:

"well they didn't work at first which sort of put me off from using them, and then when they were working it was quite a hassle to get all the bits and pieces out to use them" [pM - second interview]

"yeah they were a bit of a pain to actually use" [pT - second interview]

This is a limitation of using prototype devices in these case studies. Field trials are reliably unreliable – although they give us the opportunity to assess the technologies in the correct environment, they also highlight unfortunate issues with the prototypes which would be corrected in complete products. It is all the more remarkable then that hotMitts scored as highly as it did in the SP scores.

Forming Connections

The first emotional response that our participants had to the hotMitts was one of fun and novelty:

"they were quite fun to use, especially with Skype" [pM - second interview]

"it was weird to begin with, but after a while it definitely made me feel more connected to pT" [pM - second interview]

Given the lack of mainstream tangible communication technologies or mainstream co-creation technologies, this sense of novelty and fun is unsurprising. Beyond that, we cannot read too much into this sense of novelty.

This sense of fun carried over into the participants use of the hotMitts; to repair relations after arguments:

"I think they were quite good if we'd had a bit of an argument, we couldn't really help but talk and smile when we used them" [pT - second interview]

"we used them because we had argued and we were trying to get closer again" [pM - daily diary]

"hotMitts helped us to feel closer again and calm down" [pT - contact diary]

"I think it was if we were feeling a bit separated or missing each other a lot that we got them out" [pM - second interview]

Throughout the data we have presented here, this specific purpose has been highlighted. The other main reason for hotMitts being used was our participants missing one another. The apparent reason that hotMitts lends itself to this behaviour is that it helps form meaningful connections between the couple. This was partly due to the devices being a shared activity that the participants could perform together:

"I think we'd argued a fair bit and it sort of helped us... and then i got myself into an emotional girly mess" [pT - second interview]

"even if they didn't work, it was the only thing we can really do together" [pT - second interview]

One of the most dramatic changes to a relationship which becomes a long-distance relationship is the limited opportunities to revel in tangible acts (such as holding hands). Many of those acts which are meaningful in a relational setting (hugging, cuddling, kissing etc.) involve tangibility. This was recognised by our participants:

"it was nice, physical contact is the one thing you can't have when you live apart" [pM - second interview]

It is possible that this tangibility could be why hotMitts was used to help repair arguments.

Moving on from the in-the-moment emotional experience of using the hotMitts we should consider the longer-term value of the devices to the relationship. The feedback of our participants indicates that despite the positive impact during use, the hotMitts devices had no longer-term impact on their relationship:

"I think it had an impact at the time, like it made us feel closer for that moment, but in general it didn't really make a difference" [pM - second interview]

"it didn't really stop us missing each other" [pT - second interview]

"it was a nice idea, but the separation is always there and it'll never feel real" [pM - second interview]

"I think the problem is that its difficult to make it any easier for the pair of us, it always comes down to the fact that we're still apart" [pT - second interview]

This may be a 'good enough' result for the hotMitts devices. We've previously discussed how Social Presence is a short-term concept which impacts upon the longer-term feeling of Closeness (see Chapter 4). Our participants comments reflect a similar concept; hotMitts was impacting upon the participants feelings of Social Presence without generating any longer-term impact. Although they did not notice it, perhaps Social Presence was still impacting on their feelings of Closeness.

Having discussed how hotMitts had an impact on our participants' relationship, we now move on to discuss the underlying design facets of hotMitts and our participants' thoughts on these particular factors.

9.5.4 Design of hotHugs and hotMitts

Thus far we have considered the couple's communication routine and the impact that hotHugs or hotMitts had upon that routine. We've seen how both systems helped to form a close connection between the couple. We will now delve deeper into the particular design facets built

into hotHugs and hotMitts, namely Metaphor, Personalisation, Sensory Media, forming a One-to-One connection, Synchrony and Availability, analysing how they affected our participants view of the devices and their relationship more generally. This ordering discusses the design facets in the order presented at the end of Chapter 6 before discussing other issues.

Metaphor

Our hotHugs participants were completely content with the hugging metaphor of the system. Although the metaphor appeared to strengthen the connection formed by hotHugs, on reflection, our participants still recognised that it was a simple proxy for their partner.

"it was a cute idea and one of the main things we miss so I thought the device was a well thought out idea for a long distance relationship" [pLu - second interview]

"it did feel nice to be warmed by him but then it was still a belt and not really him!" [pLu - second interview]

hotHugs distinguishes itself by having 3 sub-metaphors, or ways of being used, Although our participants used both the chair and belt version of hotHugs, they stated that they felt little emotional difference between them; the chair version was used in order to help regulate the level of warmth felt through the belt.

The final feature of the hugging metaphor was that of consistency; being able to 'hug' the soft toy to send your partner the hug. This consistency gave the sender the feeling that they were involved in a 'hug' rather than simply pushing a button which generated a signal; an act which undoubtedly would have less emotional meaning to the sender.

"nicer to squeeze something that looks like it could be alive than just press a button or something... you get more of a feeling of actually hugging" [pLu - second interview]

Our hotMitts participants had no disquiet around using a device based on hand holding. This is perhaps unsurprising given the self-selection process of participant recruitment. That is, our participants were unlikely to volunteer to use a device based on hand holding if they were uncomfortable with the concept.

Our participants' general opinion was that the devices, as they are currently realised, is a nice idea but that they are perhaps too far removed from the realities of holding hands.

"it was actually quite a nice idea... but the way you put your hand in them didn't really feel like we were holding hands" [pM - second interview]

"they could do with being more curved so it felt like you were holding something" [pT - second interview]

If anything our data indicates that the metaphor was not strong *enough* and that the weakness of the metaphor weakened the utility of the devices. It's possible that hotHands would have been a better device for this couple. As previously mentioned, hotMitts was selected as the device to use within the case studies as our design workshop indicated that it was the device which was most likely to be most acceptable to the most number of people. On reflection, given the co-creation aspect of both hotMitts and hotHands, we should have instructed the couple to build which ever device they thought they would prefer or be most comfortable with.

Creation and Personalisation

Within the hotHugs system there are two elements of personalisation; the belts themselves and the selection of the soft toy. In terms of the belt, our participants were extremely keen on decorating them; pLu in particular decorated her belt as soon as she received it. However, this aspect of personalisation focussed more on fun than on trying to connect the couple:

"I enjoyed personalising it but I don't know if it made a difference closeness wise, just a fun thing to do" [pLu - second interview]

As Figures 9.13 and 9.14 show, the decoration of the belts did not really speak of the other person in the relationship. That said, the belts were valued by the couple, evidenced by their desire to keep them.

Figure 9.13: pLu's Decorated Belt from the Case Study

Figure 9.14: pAl's Decorated Belt from the Case Study

In contrast, the soft toys were both liked by the participants and thought to have a longer-term impact. This appears to stem from the designed purpose; that by selecting the toys together, you are generating a memory of being together which is activated when you see or use the toy.

"choosing the soft toy was definitely good too, especially as we'd chosen them together" [pAl - second interview]

"it kind of had memories of a nice day attached to it... it reminded me of him rather than just being a random toy" [pLu - second interview]

Previous research has indicated that people can feel attached to digital artefacts just as much as analogue objects [Turner and Turner, 2011, 2012]. Our participants desire to keep the belts and the soft toys reflects the couple's attachment to these digital objects, signifying their emotional value. Although we have no evidence to suggest that this influences their experience of communication through the devices, such attachment signifies value meaning that the system may support the relationship in a broader fashion, through the ownership of these devices.

Our hotMitts participants stated that they very much enjoyed making the devices as it was something fun to do. Additionally, it motivated the completion of a joint activity, something which the couple can't do while they are apart:

"well we made them together which was fun... and getting to personalise them was good" [pT - second interview]

"making the hands was a lot of fun... it was nice being able to do something together when we spend so much time apart" [pM - second interview]

Part of the co-creation process was the personalisation of the hands. This could have been completed together or separately. Again, the intention was to embed elements of the individual's partner into the device, increasing it's meaning and sentimental value. Our participants decorated the hotHand devices together in bright colours (see Figure 9.15), but not in a form which was particularly meaningful to each other:

"we just painted them in bright colours... we did it together, just tried to make them colourful" [pM - second interview]

"we did them together, I chose one colour to match my room and one to match my hair" [pT - second interview]

Although the creation process was a positive one, we found no evidence that the co-creation process was having an impact on our couple in a longer-terms fashion when they were using the device:

"[making the device] was just fun at the time" [pM - second interview]

"[it was meaningful] just at the time" [pT - second interview]

An impact may have been occurring subconsciously but we have no evidence for this. Indeed, the couple showed no reluctance in returning their cast and personalised hotHand devices indicating that they held no sentimental value to the couple. This suggests that for this particular couple, the co-creation aspect of the study held no meaningful long-term value.

Sensory Media

The physical contact that hotHugs provides was lauded by our participants. Given the inability to touch in long distance relationships, any sense of tangible communication was seen as fulfilling a need.

"I think the idea has a lot of potential though because that is the main thing missing in long distance relationships" [pLu - second interview]

In particular, pLu liked the heating aspect of the belts, arguing that it felt as similar to actual contact as you can get, whereas pAl would have preferred a squeezing sensation, something more in keeping with the metaphor behind the device.

Figure 9.15: The Decorated Hands from the Case Study

"I do like the heat idea as it's probably the more like human contact you can get really" [pLu - second interview]

"if the belt could squeeze you some how, that would have been brilliant" [pAl - second interview]

Such differences highlight some of the interaction-level concerns which would have to be addressed in any commercially viable system.

Our hotMitts participants also accepted heat as a suitable sensory medium. This could be due to the association between heat and emotional connections (see [Lee and Lim, 2010]). They recognised that heat was part of the metaphor of hand-holding:

"I liked it, just didn't correspond very well" [pT - second interview]

"heat is probably the best way, because that's you feel when you hold hands with someone" [pM - second interview]

The participants had a similar response about the location of the heat as our design workshop participants (see Section 6.1). Although the heat was pleasant, spreading it across the hand would have led to a more pleasing experience:

"it was localised to the palm of your hand which was a bit strange" [pM - second interview]

Beyond that, our participants were comfortable with the use of heat to create a phatic connection between them.

One-to-One

The hotHugs system was designed such that only your partner could send you 'hugs'. This design decision was appreciated by our participants who considered the receiving hugs from other people would be creepy:

"it would be creepy if someone random was sending you hugs and you didn't know" [pAl - second interview]

"I feel with friends it wouldn't really be necessary as I more miss conversations than actual physical contact... even with family I don't think it would be really necessary" [pLu - second interview]

The reason appears to focus around what behaviours you are happy to share with people when co-located. The intimacy of a hug is one which many people reserve for a select set of people; therefore, using the metaphor of hugging means that people want to use the system with a similar set of contacts. Doing otherwise breaks the level of intimacy inbuilt into that specific relationship. The logical progression of this argument leads us to conclude that by mimicking hugging, the level of intimacy within the communicative act is increased.

The hotMitts participants were also instinctively favourable to the one-to-one design:

"I think that would be a bit weird, I don't hold hands with anyone except pT" [pM - second interview]

"well I never really hold hands with anyone else.... I'm not the type to be like that haha" [pT - second interview]

On reflection, both participants could think of both individuals or circumstances where they would perhaps like to use it with other people. The examples our participants mentioned were either homesickness or young children within their close family:

"although if I go away without family I do get homesick... maybe they would be useful for that" [pT - second interview]

"although, I guess using it with a small child who was close family might be quite nice" [pM - second interview]

This position fits with our findings from the interview studies (see Chapter 6). People instinctively want a one-to-one link with their partner for reasons of both privacy and intimacy. However, this is not a straight binary choice of the system being open or closed; in particular circumstances, the level of openness needs to adapt. The relationships that people share require different types and levels of support based on dynamic factors (such as health, special occasions or emotional well-being). Our data suggests that communication technologies need to be flexible to deal with such situations whilst preserving the sense of intimacy that one-to-one communication provides.

Synchrony

Although the system was conceived as a synchronous technology, when asked about the possibility of leaving 'tangible voicemails', our participants were very keen:

"yeah actually I think that's a really good idea to be able to leave a hug for later" [pLu - second interview]

"I think that's a brilliant idea" [pAl - second interview]

We anticipated that people would prefer live links such that they felt more connected to their partners. pAl and pLu felt that being able to leave a message was nicer for two main reasons. The first was that when you're speaking to your absent partner, you are already connected so are not missing them as much as when you have no contact. The second related aspect is that

by contacting the person at random times (i.e. serendipitously) you are showing them that you are thinking of them, bringing the couple closer together.

"I think it would be better that way because when you're not speaking to them is when you miss them most and it would be really nice to receive something later on" [pLu - second interview]

"I think it would possibly make you feel closer, as the hug would show that the other person was thinking about you, and wanted to send you a hug to show that you miss them/love them" [pAl - second interview]

Such findings directly contrast with those in the hotMittss study. Our hotMitts participants did not think the concept of an asynchronous hotMitts system would work; that leaving a tangible voice-mail would not help the participants maintain their relationship:

"I don't think it would feel as realistic, not sure I'd like it" [pT - second interview]

"it's not really the same, holding hands without them being there" [pM - second interview]

Seemingly asynchrony was not appealing for two reasons. The first was that leaving a tangible message didn't form a strong enough connection between the users, dramatically decreasing it's utility. The second reason is that our participants tended to use text as the primary means of maintaining a connection without having to be available to communicate at the same time:

"if we do things like that, i'll post a message on his Facebook for him to see later or pM sends me a sweet text when i go to sleep" [pT - second interview]

Availability

Something which we did not consider when designing hotHugs was the availability of the system. Being fixed to the home, the couple had limited opportunities to use the hug belts. The couple would have liked to have the ability to have used the system at other times and in other places:

"or if you could make a portable one, so you had it as a bracelet or something, connected via your phone, so you could receive hugs any time... something like your your heating device, but one that was on you at all times so it could be completely random and a nice surprise" [pAl - second interview]

Such a device would be in addition to hotHugs. Although the bracelet would always be available, not having a grounding in a co-located behaviour limited it's intimacy compared to hotHugs. As we will go on to discuss, similar concerns were raised when considering questions of synchrony. By increasing the opportunity to communicate, hugs could be sent and random times and thus increase surprise:

"I think it would be really good as a random surprise when you weren't expecting it" [pLu - second interview]

9.5.5 Discussion and Conclusion

In terms of hotHugs, our analysis has shown the specific ways in which our participants found that hotHugs was useful in supporting their relationship. It was associated with levels of Social Presence akin to using Skype and the telephone, partially answering RQ3. Despite this, our

participants thought that hotHugs would not have a longer term impact on their relationship, in contrast to pLu's Closeness scores. Our participants may have been considering impact on a longer-term scale than Closeness.

Many of the design facets built into hotHugs were found to be positive. Our participants were comfortable with the hugging metaphor and that heat was a suitable way to form an emotional connection between the couple. The one-to-one connection was appreciated, not necessarily because it created a sense of intimacy but because it would be weird to hug someone other than their partner. Our participants also liked the consistency between hugging the soft toy and receiving a hug through the belt as this involved the sender in a meaningful way.

In contrast to our hotMitts participants the hotHugs participants were very keen on personalising the belts. Although this was considered to be more fun than intimate, both participants wanted to keep their belts. This indicates that the belts themselves held some form of value within their relationship.

Our participants were also very keen on the idea of some form of tangible voice-mail. This is in stark contrast with out hotMitts participants. This keenness is related to the synchrony of the device. Both pLu and pAl felt that when they were talking to one another they already felt close to each other. Therefore some form of device, which retained the tangible aspects of hotHugs, which was asynchronous, would be appreciated. Regulating their level of intimacy in this way differs from our sleepyWhispers participants who appreciated asynchrony due to scheduling issues (see Section 9.4).

This case study has found that hotHugs was associated with high levels of Social Presence, partially answering RQ3. We have also explored our participant's views with regards to some of the design facets built into hotHugs, strengthening our answer to RQ2. We found that some design facets (namely sensory medium, reciprocity, openness and metaphor) were appreciated while others (such as personalisation and serendipity) were more complicated. In Chapter 10 we combine these findings with the results of the other four case studies in order to discuss how they assist us in answering our two primary research questions, RQ2 and RQ3.

It has been clear throughout our discussion that our participants found that hotMitts was useful for repairing their relationship after arguments had occurred or when the couple were particularly missing one another. This specific use meant that hotMitts was not associated with a particularly high level of Social Presence, being scored on a similar level to the telephone. Additionally, our participants thought that it wouldn't have much of a long-term impact, that despite it helping after arguments, whatever happens, the couple are still apart:

"I think the problem is that it's difficult to make it any easier for the pair of us, it always comes down to the fact that we're still apart" [pT - second interview]

Many of the design facets built into hotMitts were found to be positive. Our participants were comfortable with the hand-holding metaphor and that heat was a suitable way to form a phatic connection between the couple. Having a tangible interaction was found to be particularly useful when undertaking relational repair. We have established that the 1-to-1 connection was appreciated for the sense of intimacy engendered although both participants could think of particular situations where they might like to use hotMitts with other individuals.

Most surprisingly, our participants had no sense of sentimentality regarding the co-creation process. The participants returned their personalised devices as they did not want to keep

them. We anticipated that casting their hands would create a special memory which our participants would reflect on when using the device. This did not occur within this case study. There are three different interpretations of why our participants did not experience this sentimentality. The first is that the individuals in this case study simply were not particularly sentimental. Our hotHugs participants were extremely keen to keep their decorated belts. A second interpretation is that the participants didn't use the hotMitts for long enough or that they didn't want to keep an artefact which no longer worked (due to cost, the participants could only keep the casts, not the electronics which make the devices work). The final interpretation is the the design facet is simply not valid. Given the results of the hotHugs case study, we argue that a combination of the first and second interpretation is most likely to be an accurate reflection of our participants' reasoning.

This case study has found that hotMitts was associated with levels of Social Presence comparable to use of the telephone, partially answering RQ3. We have also explored our participant's views with regards to some of the design facets built into hotMitts, strengthening our answer to RQ2. We found that some design facets (namely sensory medium, synchrony, openness and metaphor) were appreciated while others (metaphor, personalisation) were not involved in the emotional connectedness of the couple. In Chapter 10 we combine these findings with the results of the other four case studies in order to discuss how they assist us in answering our two primary research questions, RQ2 and RQ3.

9.6 Conversation, Emotion and Appreciation Topics

In addition to the Social Presence scales, the contact diary asked for three other pieces of information – what the couple talked/wrote about, how it made them feel and why and also whether (and why) the exchange made them feel appreciated. For all five case studies, the results are very similar.

These three facets show some indication of having an impact on feelings of Social Presence. However, the limited opportunity for statistical analysis (unable to perform a regression test) prevent strong inferences being made (details of this analysis can be found in Appendices F through J).

In terms of appreciation, there is generally a decrease in SP from communication acts where the responder felt appreciated to those where they did not. The reasons for feeling appreciated are also unsurprising; Being Missed and Being Involved/Together were generally associated with the highest levels of SP whereas negative reasons (feeling Unimportant, being Moaned At) were generally associated with the lowest levels of SP.

The conversation topics were divided by those which might be termed 'Emotional' (i.e. 'Being Together') which were associated with higher levels of SP as compared to those topics which were more functional (i.e. 'Work/Jobs'). The other conversation topics were associated with middling levels of SP.

The Feelings categories again match expectations; 'Seeing each other', 'Cared for' and 'Missing each other' are highly ranked whereas 'Annoyed' and 'Upset/Guilty' are all associated with low levels of SP.

Given the unexceptional nature of these findings, and the limited conclusions we can draw from the analysis, there is little need to discuss them further.

Having presented the details of each of the case studies, the next Chapter moves on to consider, compare and contrast the collective results from the case studies and analyse how these results can help us answer our research questions.

Chapter 10

Case Study Conclusions

In the previous Chapter we have presented case studies which have explored the use of our devices by five different long-distance couples. The particularities of their everyday arrangements have helped to present a range of perspectives on routine closeness. Chapter 6 brought together a set of insights from lab-based interviews. It argued that it is important to reflect the characteristics of routine communication in design thinking for supporting LDDRs. In this Chapter we discuss how the commonalities and differences between the studies help to inform our investigation.

The case studies thus serve to address two of our main research questions:

> **RQ3: Do novel designs for devices based on the design facets from RQ2 engender positive feelings of emotional connectedness?**
>
> **RQ2: What design facets are significant when considering the design of communication technologies for long distance dating relationships?**

We will first consider RQ3 before moving on to discuss RQ2.

10.1 The devices and Social Presence scores

Research Question 3 is addressed by considering whether devices based on the mimicry of co-located behaviours engendered a high level of Social Presence. This speaks to a larger concern regarding whether these devices could help to support a LDDRs' relationship.

The devices were associated with different levels of Social Presence when compared across the different case studies. HotHugs and doodleMessenger were associated with levels of SP that ranked just below being face-to-face. SleepyWhispers and hotMitts were associated with more moderate levels of SP, similar to those scores recorded for conversations on the telephone. The Magic Sock Drawer was somewhat unique in that there was no significant difference in Social Presence scores across communication technologies and so comparisons are less clear cut.

These results indicate that in some circumstances devices based on co-located behaviours can engender relatively high levels of Social Presence. The MSD case study suffered from a number

of technical flaws which, coupled with the paucity of the data set, could account for the low level of SP. We acknowledge that a couple have to be amenable to integrating the device into their pre-existing communication routine. In all cases, the particularities of the relationships cannot be factored out of our results. Our data must be treated as being indicative rather than a definitive statement about the power of the devices to evoke the presence of a distant loved one.

In the next Section we go on to discuss how different applications of our design facets helped to create these feelings of SP.

10.1.1 Routine

hotHugs was used in conjunction with Skype which was already used to connect the couple. However, the couple did feel that an asynchronous system would have integrated better with their routine as they already felt close when using Skype. doodleMessenger was used in conjunction with whatsapp while sleepyWhispers was used as an asynchronous alternative to using the telephone. hotMitts was used in conjunction with the couple's extensive use of Skype. In contrast, the technical faults associated with the MSD meant that the device could not be fully integrated into the couple's routine.

In addition to fitting within the couple's routine, our devices seemed to fulfil specific roles within their LDDR communication ecology. In general our couples used synchronous technologies such as Skype and the telephone to remain emotionally connected whilst messaging technologies were used predominantly for logistical purposes. On occasion, emotional pings were also exchanged through messaging technologies.

Our devices filled roles distinct from these. Our messaging technologies (doodleMessenger, sleepyWhispers and the MSD) were predominantly used to exchange fun messages, based around humour or personal idioms. Our synchronous technologies were used more for forming emotional connections. hotHands was used exclusively to repair the couple's relationship after arguments had occurred while hotHugs was used as a replacement mechanism for touching one another, forming an emotional bond.

Our case studies show no clear relationship between the synchrony of the devices and the ratings of Social Presence associated with them. However, there is a distinction between asynchronous and synchronous devices in terms of how they relate to other design facets in our design space. The asynchronous devices were typically used for fun and frivolity. This feeling of fun is generated, at least in part, by the ability to craft personalised messages containing elements of personal idioms and humour. In contrast, the synchronous devices were used as a means of connecting the couple with fun not being a major aspect of this connection. Instead, we should note that the element of touch was far more significant for these synchronous technologies than it was in the asynchronous systems. This is likely due to the fact that the element of touch is something which is missed from LDDRs and becomes particularly salient when trying to form an emotional connection with your absent partner. We should note that these connections were not planned, nor are they definitive. They simply exemplify how a decision about a single design facet can act as a catalyst in determining what other facets become significant.

This is significant as it indicates that the devices are more likely to generate strong feelings of Social Presence if they hold a particular purpose within the couple's communication routine.

This is perhaps one of the more striking findings from our case studies. We have previously described couples' communication routines as mechanisms of convenience; a way of regulating the times and media used to communicate. The way our participants described their communication routines ascribed them more meaning than this. Not only is it convenient, a couple's routine appears to be somewhat akin to a personal idiom in that the routine itself has emotional meaning. By being something shared by the couple, the routine itself helps to bring the couple together. In terms of designing devices to support LDDRs, there are two interpretations of how we can harness couples' communication routines. The first is that building devices which complement people's existing routine, by providing an additional channel of communication to a pre-existing device, not only increases the probability that the device will be used but could also increase the emotional meaning of using the pre-existing device. The second interpretation is that prior to designing a new device, it is necessary to understand where LDDRs feel that there is a gap in their existing routine. By designing a device which could be used to fill that gap, the likelihood of the device being adopted is increased.

10.1.2 Conversation, Appreciation and Feelings

In all of the case studies we briefly considered the impact that the topic of conversation, the feeling engendered by the communicative act and the sense of appreciation after the communicative act impacted feelings of Social Presence. In every study the findings match what you might expect. In terms of appreciation, there is generally a decrease in SP from communication acts where the responder felt appreciated to those where they did not. Conversation topics were generally divided by those which might be termed 'Emotional' which were associated with higher levels of SP as compared to those topics which were more routine. The Feelings categories also matched expectations; positive emotions were associated with high levels of SP compared to more negative emotions. Given that our primary interest is in designing communication technologies, we did not discuss how these different aspects of a communicative act could affect feelings of Social Presence, nor how they could be related to the design of communication technologies. Such concerns go beyond the scope of this thesis but we discuss them further in Chapter 11 when considering what elements of further work this thesis highlights as being potentially interesting.

10.1.3 Long Term Impact

In terms of our devices having an impact on our couple's relationships beyond specific acts of communication, our data is more limited. We have no Closeness data for sleepyWhispers, hotMitts and the MSD showed no difference in Closeness scores across the different phases of the study. One participant from each couple using doodleMessenger and hotHugs showed an increase in Closeness ratings from pre- using the device to during- and post- using the device. This is indicative that the devices may have a longer term impact beyond single acts of communication. Such a position is strengthened from our findings in Chapter 4 which argued that Social Presence scores helped to predict feelings of Closeness.

We now move on to discuss how our case studies inform our discussion of what design facets are significant when considering the design of communication technologies for long distance relationships.

10.2 Design Facets

We have discussed at great length the development of the design space (see Chapter 5) and participants' responses to these facets of design within a laboratory setting (see Chapter 6). The case studies allowed us to explore people's reactions to some of these design facets, as realised in the devices, within their own distance relationship.

We primarily explored these design facets through the qualitative aspects of the studies, particularly the second interview where a section was dedicated to questioning our participants about specific design facets. These results are discussed at length within the case studies. In order to identify commonalities and differences between our participants' responses, Table 10.1 collates our findings together. We order the 10 design facets in the design space by device, as reported in our case studies. In Section 5.4 we described how the ability to place devices within a design space provides a level of confidence that a conceptual design space covers those facets which are important in the design of devices. In Section 6.5 we described how our devices fitted within our design space. Table 10.1, based on our participants' views, provides further evidence that our design space covers the main facets of designing devices for LDDRs.

The first thing to note is that each of the design facets has at least three responses. This indicates that each of these facets conceptually maps part of the potential design space for LDDR communication technologies in a manner that meaningfully relates to the lived experience of our participants.

The personalisation aspect of each of the devices was liked; the more creative aspect of the devices (e.g. casting the hands or crafting the notes) were generally described as being fun to perform. The messaging technologies frequently utilised personal idioms to foster a more intimate connection which the decorative elements of personalisation did not provide. The generation of a personal memory through the selection of a soft toy (for hotHugs) is worth highlighting as it was discussed in terms of creating a sense of intimacy whenever the toy was seen.

The MSD and doodleMessenger encouraged the investment of meaningful effort in the creation of notes. This effort was appreciated by the receiver and increased the value of the messages. However, such feelings were not generated by sleepyWhispers where the effort of recording a message was not considered to be meaningful. This indicates that when designing effortful systems great care must be taken to ensure that the effort is perceived as being meaningful by both the sender and receiver of the message.

Touch was generally highlighted as a positive form of communication, especially as touch is a missing element from LDDRs. The heat-based systems were considered to connect the distance partners. This corresponds with prior work which argued that heat was a suitable interaction medium for exchanging emotion [Lee and Lim, 2010].

Our participants were generally comfortable with our devices' underlying behavioural metaphors but we found limited data suggesting that understanding these metaphors led to an increase in intimacy or Social Presence when using the devices. Where the metaphor worked, the device was powerful. Where the metaphor did not work, the integration of the device into LDDRs' communication routines is better explained via the other facets.

Our participants generally liked realised messages as they appreciated the ability to display the notes; reliving the experience of receiving the message every-time they see the display. Our

sleepyWhispers participants disliked creating fleeting notes as it increased their stress levels when recording messages for fear that their message would be unintelligible.

With have limited data indicating that serendipity was pleasant when the communication system could be relied upon. That said, our sleepyWhispers participants would have preferred a notification as to when they had received a message. This was a factor which our participants had few opinions on. There is a clear tension between maintaining a sense of surprise whilst simultaneously trying to integrate a technology into a couple's routine. How is it possible to maintain a sense of surprise in the long-term as the device becomes a means of maintaining a sense of habitual intimacy? This is a question to which we have no answer. One potential aspect to explore would be whether there is a distinction to draw within routines between temporal choices and using devices for specific purposes. This is something we will discuss further in Chapter 11.

Our participants generally argued that synchronous means of communication were better at forming an emotional connection between the distance couple. That said, our sleepyWhispers participants liked the asynchronous nature of their device as it built on top of their pre-existing communication routine. Our data indicates that it matters less whether the system is synchronous or asynchronous than whether the device fits into the couples pre-existing communication routine.

We have limited data regarding the reciprocal nature of our devices. Our hotHugs participants enjoying the consistency between hugging the soft toy and the belt-based hugs as this helped the sender to feel involved in the communicative act. Our doodleMessenger participants didn't typically reciprocate with a note due to the time necessary to create a note. Our MSD pilot participants highlighted that they were upset when they received no note back as the investment of effort created an imbalance within the relationship and a sense of not feeling appreciated by their partner. It may be that reciprocation has an inherent relationship with effort: support for high-effort appreciation may only work if reciprocal expectation is simultaneously designed out of the interaction model. This highlights the way in which different facets of the design space can complement one another even if this occurs in an asymmetric way.

Participants had mixed views regarding the openness of the system. The hotHugs and MSD pilot participants liked having a 1-to-1 system due to the specialness and value it engendered. The sleepyWhispers participants liked the 1-to-1 connection due to the privacy of the messages. Although the hotMitts participants valued the specialness engendered by a 1-to-1 connection, they were comfortable in the idea of using the system with other people in certain situations. The MSD and doodleMessenger participants saw no value in limiting the system to a 1-to-1 level of openness. This difference of opinion appears to relate to the nature of the message being communicated – those systems based on directly communicating touch (which were also based on highly intimate behaviours) are less applicable to wider relationships compared to those devices based on exchanging humorous notes. There appears to be no clear link between openness and synchrony or reciprocity.

The doodleMessenger participants liked the ability to create notes whenever inspired to do so, especially as this meant they could create meaningful notes whenever they wanted to do so. The hotHugs, MSD and MSD pilot participants all wanted a mobile version of their device as they felt that basing their communication system in a fixed location was a major disadvantage and limited the messages that they sent.

Broadening our analysis, let us consider our participants' responses to the design facets as described in Table 10.1. All six of our case studies reported views on personalisation and openness, five case studies reported views on metaphor and serendipity. Effort, fleetingness and availability were discussed by four of our case study couples whilst sensory medium, synchrony and reciprocity were discussed by three of our case study couples. These should not be read as indicating a sense of importance from high to low; instead they reflect the salience of particular design facets by our participants as realised within specific devices. Furthermore, the meaning of particular combinations of facets cannot be derived without reference to the mix of opportunities and circumstances that define any given LDDR.

There are some connections between specific design facets which are worth noting. We have already discussed how synchrony was related to both personalisation and the selection of sensory medium. Our hotMitts participants also expressed views which linked fleetingness to synchrony; the participants appreciated the live linked formed through the synchronous connection but disliked the idea of a realised voice-mail as it would lessen the connection between them. We should note that none of the synchronous devices we have developed result in a realised form of communication.

Table 10.1 also shows that three of the studies (MSD pilot, MSD and doodleMessenger) highlighted the tangible nature of the notes, connecting the realised form of the messages with the sensory medium used to perceive them. We have already highlighted that there is no direct connection between the two facets; for example, the hotMitts system creates a fleeting tangible link between participants. However, the fact that these participants highlighted the tangible nature of the notes indicates that there is an association between fleetingness and sensory medium.

The final combination of factors to discuss is personalisation and effort. We have described effort as being the meaningful investment of effort in the construction of a communication message. Within our case studies we should note that discussions of effort all revolved around elements of personalisation. We will discuss whether it is possible to create a device which encourages the investment of effort without inserting elements of personalisation in Chapter 11.

We have previously made clear that our design space is intended to map out the conceptual space within which devices to support LDDRs exist within. The facets within the design space are not intended to have value judgements ascribed to them. Instead, the point in discussing our case study participants' views on the facets of the design space is to demonstrate that the facets have a meaningful impact on the design of the devices. Whilst the case studies may have further expanded the design space, we have found no additional design facets to add to the design space. On that basis, the coverage of the design space is at least adequate for fostering design-relevant analyses of LDDRs.

Design Facet	**MSD Pilot**	**sleepyWhispers**	**hotMitts**	**doodleMessenger**	**hotHugs**	**MSD**
Metaphor	–	pK liked using the pillow as an existing artefact, pZ didn't value it	Liked the hand-holding metaphor though would have preferred a stronger metaphor	Enjoyed sharing notes	Content with the hugging metaphor although found no emotional difference between the sub-metaphors	Comfortable with sharing notes
Personalisation	Liked, was associated with a more personal connection	Idiomatic messages were liked. No increased value in using voice due to using the phone so much	Enjoyed making the casts and painting them but thought that personalisation had no long-term impact	Liked although found it difficult as to verbalise why. Liked the use of personal idioms to create a personal connection	Although fun, the decoration had no wider impact. The selection of a soft-toy increased intimacy as it was associated with a relationally significant memory	Used exclusively in a personal way, focussing on humour and personal idioms

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Table 10.1 – continued from previous page

Design Facet	MSD Pilot	sleepyWhispers	hotMitts	doodleMessenger	hotHugs	MSD
Effort	Liked, appreciated the investment of effort in the notes	Too effortful to send a message. Would have preferred a streamlined method of recording the notes, preferably using the photo frame. Appreciated the creation of notes which were effortful to create	–	Appreciated the investment of effort in creating the notes. Found to have an emotional impact	–	Appreciated the investment of effort into the notes although disliked investing effort when notes were never received
Sense	(see fleeting/ realised)	pZ did not like recording her own voice. No emotional benefit due to frequent use of the telephone	Heat was liked due to emotional connotations	(see fleeting/ realised)	Touch was liked as a missing element of LDDRs	(see fleeting/ realised)
Fleeting/realised	Liked the tangibility of the notes	Listen-once feature increased stress. Some indication that valued notes would be kept	(see synchrony)	Would have preferred a physically realised note (although did display the digital notes)	–	Appreciated the ability to display the notes

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Table 10.1 – continued from previous page

Design Facet	MSD Pilot	sleepyWhispers	hotMitts	doodleMessenger	hotHugs	MSD
Openness	Appreciated the specialness and value it engenders in the notes	Liked the privacy of the 1-to-1 notes	Liked the intimacy engendered but would possibly use with other people	Only sent messages to one another so no sense of specialness	Liked the intimacy of the 1-to-1 link, weird to hug anyone else	Saw no value in the 1-to-1 connection
Synchrony	–	Asynchrony was liked as it built on top of their existing routine	Liked synchrony as it formed a strong personal connection. Disliked the idea of tangible voice-mail due to a lack of connection	–	Liked although they already felt close when talking. Liked the idea of tangible voice-mail	–
Reciprocal	Felt sad when no notes were sent back	–	–	Not typically reciprocal due to the method of exchanging the notes	Liked the correspondence between hugging the toy and receiving a hug through the belt	–

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Table 10.1 – continued from previous page

Design Facet	**MSD Pilot**	**sleepyWhispers**	**hotMitts**	**doodleMessenger**	**hotHugs**	**MSD**
Serendipity	More concerned with privacy concerns than serendipity	Would have liked to have been alerted when there was a message to listen to	Liked the idea of serendipity although couldn't see how it could be used with hotMitts	–	Liked the idea of tangible voice-mail that could be found serendipitously	When occurred, pleasant. Subverted due to technical uncertainty
Availability	Would have preferred a mobile version	–	–	Liked the ability to create notes whenever inspired to do so	Would have preferred a mobile alternative although acknowledged that the lack of a hugging metaphor would have limited it's emotional impact	Would have preferred a mobile version

Table 10.1: Case study design space responses

10.3 Summary

This Chapter aimed to analyse whether our prototype devices would help support long distance dating relationships through engendering a strong sense of Social Presence. Additionally the studies allow us to examine our proposed design space through ecologically valid use of the devices. The five case studies have assisted us in addressing two of our primary research questions, to whit:

- **RQ2: What design facets are significant when considering the design of communication technologies for long distance dating relationships?**

  RQ3: Do novel designs for devices based on the design facets from RQ2 engender positive feelings of emotional connectedness?

To summarise our findings, these studies have found:

- Empirically we have collected five new sets of ecologically valid data to investigate the impact our devices may have had upon long distance dating relationships
- Methodologically the studies are an improvement on previous work by investigating our devices and design space in a robust and comprehensive manner
- Our data indicates that devices based on the mimicry of co-located behaviours can engender a strong sense of Social Presence
- We have a limited amount of data which suggests that the devices may have had an impact on some participant's feelings of emotional connectedness
- We have discussed how the facets of the design space, as realised within our devices, were perceived by our case study participants

Having contrasted and compared the results of our five case studies, we have established the significance of the design facets within our design space in designing communication technologies for LDDRs. This answers RQ2 although we are clear that our design space is not complete in the sense that it does not contain all of the design facets which are meaningful in the context of LDDRs.

We have also discussed how certain combinations of these facets, as realised in specific devices (such as hotHugs and doodleMessenger) can result in these technologies being associated with high levels of Social Presence. Other devices, also based on the mimicry of co-located behaviours, such as sleepyWhispers and hotMitts results in levels of Social Presence commensurate with using the telephone. This answers RQ3.

Within this Chapter we have focussed on the results of our five case studies. In the next Chapter we broaden our perspective to consider what we can conclude on the basis of this thesis and what elements of further work could further extend our understanding of how to support LDDRs through the design of communication technologies.

Part III

Conclusions

Chapter 11

Conclusions

11.1 Thesis Summary

This thesis was motivated by a desire to develop an understanding of how to design communication technologies to support Long Distance Dating Relationships. We made use of 'Social Presence' as a means of assessing how successful a given communication device is in 'connecting' a couple during an act of communication. This lens was sufficient for providing a quantitative measure of success of in-the-moment communication but was less helpful over the course of a LDDR. We introduced the concept of 'emotional connectedness' as a way of integrating our SP data with our qualitative data to provide a more rounded assessment of a given communication technology.

In Chapter 2 we begun by discussing what relationships are and why they are meaningful to people. Having established the importance of inter-personal relationships we moved on to consider some of the peculiarities of LDDRs, particularly regarding the way in which they communicate. We introduced the concept of Social Presence and explored how it was affected by both user characteristics and media characteristics.

We moved on in Chapter 3 to consider the broad methodological approach taken across the thesis. We determined that field studies rather than laboratory experiments were the most appropriate approach to use within this thesis. We discussed the various measures which could be used to measure feelings of Social Presence, settling on the Semantic Differentials measure of Social Presence. Accepting the shortcomings of many of the measures of Social Presence, we stated that we would collect qualitative data alongside measures of Social Presence. We argued that thematic analysis would be an appropriate technique to analyse our data with.

In our first study in Chapter 4 we build on our analysis of the Social Presence literature to gain a better understanding of how we might use Social Presence as a phenomenological concept within LDDRs. Through a diary study, we established that Social Presence is a suitable concept to support long-distance relationships through the design of communication technologies. We additionally demonstrated how Social Presence ratings from individual acts of communication predict feelings of Closeness experienced daily by an individual. This study confirms that communication experiences associated with feelings of Social Presence can have an impact beyond specific acts of communication.

We then move on to discuss the design and development of devices for LDDRs in Chapters 2 and 5. After explaining how the devices embody certain design concepts, we went on to consider how they might fit into a LDDR design space. Key facets of communication technologies were explored in order to map the conceptual space in which devices might support Social Presence. The initial design space consisted of personalisation, sensory medium, effort, openness, metaphor and fleetingness.

In Chapter 6 we presented two interview studies which explore people's attitudes towards the communication technologies we've developed. After introducing the design idea, participants had a hands-on demonstration of the prototype device, before finally discussing, comparing and relating their experience with each demonstrated device to their own romantic relationship. As a result of these interview studies, four further facets were added to the design space, namely synchrony, reciprocity, availability and serendipity/anticipation.

The set of case studies in Chapter 9 were intended to explore how people used the various devices within their own relationships and whether the communication acts which used the devices were associated with high levels of Social Presence. In Chapter 10 we collate the findings from these studies, establishing the significance of our design space facets within LDDRs and how successful our devices were in supporting our cast study couples' relationships.

Within this Chapter, we bring together the results from all of our studies to identify what the main conclusions of this thesis are. We clarify what our main contributions are in theoretical, practical and methodological terms alongside exploring what areas of further work this thesis reveals as being interesting. We address these concerns thematically, first discussing our process of defining Social Presence before reflecting on the development of the devices. We then explore our design space, examining the space as a whole before reviewing four specific facets and their theoretical implications. Finally we review our methodological process, examining what aspects of it worked and which, on reflection, we would have changed.

11.2 Defining Social Presence

Social Presence has been the main theoretical basis of this thesis, being used as a phenomenological measure of how successful a communication technology is in supporting long distance dating relationships. Throughout this thesis there were no clear differences between the results from the Semantic Differentials measure and our qualitative data.

At the beginning of this thesis we identified that the Social Presence literature was lacking within the specialised context of long distance dating relationships. This stimulated our first research question:

> **RQ1: How should we think about Social Presence with regards to close personal relationships?**

We should reiterate that within this thesis we have followed Short et al.'s original definition of Social Presence as "the degree of salience of the other person in the interaction and the consequent salience of the inter-personal relationship" [Short et al., 1976, p. 65]. However, to reprise our discussion of the Social Presence literature in Section 2.4, we argued that Social

Presence has historically been treated purely as a quality of the medium. We argued against this perspective, citing work from [Hauber et al., 2006] and [Connell et al., 2001] which indicated that feelings of Social Presence went beyond a simple sum-of-cues issue as argued by Media Richness Theory [Daft and Lengel, 1986]. We instead concurred with the argument that feelings of Social Presence are based on both (i) media characteristics (such as synchrony) and (ii) user characteristics (such as gender, age, traits and experience) as proposed by Ijsselsteijn and Riva [2003]. User characteristics in this thesis are encapsulated by the specialness of LDDRs. The literature currently does not provide an understanding of what those media characteristics are with regards to LDDRs. It was also unclear whether enduring feelings of connectedness occur independently of instantaneous communication experiences. This stimulated much of the design work discussed in Sections 11.3 and 11.4. We should also note that we will reflect upon the discussion in Chapter 3 regarding measures of Social Presence in Section 11.5.

Chapter 4 presented a study designed to clarify our understanding of Social Presence. Based on the identified shortcomings in the literature, we had four main questions:

- **RQ1.1: Do Romantic relationships differ from other relationship types in terms of SP ratings?**
- **RQ1.2: Does the Distance-status of a relationship impact ratings of SP?**
- **RQ1.3: Does the type of Communication Media have an impact on ratings of SP?**
- **RQ1.4: Do SP ratings predict feelings of Closeness?**

Through the diaries, we collected data which allowed us to address each of these questions. In terms of relationship type and relationship distance (RQ1.1 and RQ1.2), we established that distant partners are predicted to have a significantly higher SP score than co-located partners. We argued that this is perhaps unsurprising as in distant relationships communication technologies are the primary means of communication. This is likely to increase the emotional meaning of these technologies compared to co-located relationships. Similarly, the limited opportunities for face to face communication in distant relationships is likely to increase its meaning when it does occur. These findings are supported by the results from the case studies where both the hotHugs and hotMitts participants commented on how communication technologies became more important to them after moving apart.

With regards to RQ1.3, we established that face to face communication was ranked significantly higher than all of the other communication technologies reported on. We also noted a perceived distinction between a set of high SP technologies (namely Telephones and both versions of Skype) and a set of low SP technologies (namely SMS, IM, Email and Facebook). As we noted at the time, what causes the distinction between these two sets of technologies is difficult to determine. Different interpretations could involve personalisation, or sensory media, or synchrony. The diary data could not assist us in answering this question. Although this ranking of technologies is similar to that reported within the case studies, our interview data did not assist us in determining the exact cause of the difference in ranks instead indicating that it is caused by a combination of these design facets.

Focussing on RQ1.4, we established that SP ratings do predict feelings of Closeness. Both mid and low SP scores predict a lower level of Closeness than high SP scores. Additionally,

low SP scores predict a lower Closeness score than mid SP scores. This relationship informs a model of emotional connectedness that incorporates feelings of Social Presence and Closeness as proposed in Chapter 4. Our data supports our argument that each act of communication has an impact, to the extent that it generates a sense of SP, on the longer-term feeling of Closeness.

It is worth reiterating why this is of importance. The relationship between SP and Closeness indicates that through creating technologies which help to create emotionally significant experiences during acts of communication, designers have the potential to help support personal relationships in a more meaningful, long-term fashion.

We should broaden this reflection so as to consider the relationship between Social Presence, Closeness and emotion. We have collected a large amount of data about Social Presence and it's relationship to both closeness and emotion. It is worth reflecting on the contribution that this data makes in terms of how we understand the three phenomena. First of all we should note that we have gathered no data which indicates a contradictory position amongst the different phenomena (i.e. high Social Presence but low Closeness or low Social Presence and positive emotions). This indicates that all three phenomena are related in so far as they are regarded by participants as referring to a similar experience. Within this thesis we have grouped all of this data together under the term of "emotional connectedness".

In Sections 2.5 and 2.6 we discussed how Social Presence may relate to experiences of Closeness and Emotion. We hypothesised that positive emotions would be treated in a similar way to Social Presence and high Closeness and high SP would also be synonymous. All of the data we have collected indicates that the conceptual nicities are not recognisable by participants. For example, the hotHands couple indicated that when they argued, the devices helped them to restore their relationship. However, during the arguements participants recorded low levels of Closeness and Social Presence alongside negative emotions. In each of the case studies, the emotions recorded for each act of communication matched what you would expect from the Social Presence results, positive emotions for high Social Presence and negative emotions for low Social Presence.

That then is the main theoretical contribution of our data on Social Presence, Closeness and emotion. Our data supports the arguments we posited in Sections 2.5 and 2.6.

In terms of the relationship between Social Presence and Closeness, we hypothesised that within a given relationship communicative acts with high levels of SP increase feelings of Closeness and acts with low levels of SP decrease feelings of Closeness. This corresponds with the concept of Closeness as a relational quality where Closeness is in some way a longer-term feeling of the same phenomenon as SP. Additionally we also recognise that SP and Closeness can be linked through the concept of Closeness as a relationship type. In Chapter 4 we noted that relationships which can be characterised as being 'close' are predisposed towards stronger feelings of Social Presence due to the pre-existing emotional bond between the interlocutors. Finally our data supports the naive assessment that communication acts containing positive emotions will engender higher levels of SP than acts of communication containing negative emotions.

These findings have empirical, theoretical and practical contributions. Empirically we have collected a new set of data to investigate the factors which have an impact on ratings of SP in addition to establishing an association between Social Presence and Closeness. This is a data set which is accessible if other researchers which to analyse it for different facets which we have not explored. This data set is available online at `http://people.bath.ac.uk/dg216/audit`. All

names which appear in the files have been changed. Those documents where anonymization would be too complicated (for example, in the Case Study diaries completed for Part 2 of this thesis) are not included but are available on request. Theoretically our data extends our understanding of Social Presence by determining that relationship type and relationship distance are both user characteristics which can affect ratings of SP. We have also demonstrated that SP operates as a predictor of the longer-term, relationally meaningful phenomenological concept of Closeness. Practically our results indicate that Social Presence should be used as a measure of how successful a communication technology is in supporting long distance dating relationships as well as other relationship types/distances. More broadly, our data also suggests that SP is of some importance as it is a predictor of longer-term Closeness. This is of particular importance as historically many communication devices are developed and not evaluated, as we discussed in Section 2.8.

We should now consider how useful Social Presence was as a phenomenological concept in the context of our design activities intending to support LDDRs. In terms of a concept underpinning the development of devices, there is no direct connection between Social Presence and our design activities beyond using it as a motivating concept. If asked to develop a communication device to support Social Presence for other contexts, such as business relationships, there is no direct guidance or mechanism we have created which will allow others to achieve that.

The means through which Social Presence is supported within design is through the design space we have created (see Section 11.4). In terms of specific factors, as we discussed in Section 6.4, SP has a direct relationship with the facets of personalisation, openness, synchrony and serendipity. The other design factors (metaphor, effort, sense, fleetingness, reciprocity and availability) are only linked to Social Presence through the concept of emotional connectedness. We will discuss the methodological implications of the concept of emotional connectedness in Section 11.5. The connection between Social Presence and media characteristics, limited as it is, is a theoretical contribution. It extends our understanding that Social Presence varies between different communication technologies by describing those facets of a communication system which actually assist in creating the sense of Social Presence experienced within an act of communication, at least in the context of LDDRs.

Having the concept of emotional connectedness within the thesis could be seen as an indication that Social Presence is not a suitable concept to support LDDRs as it cannot be used as the single driving force behind the development of communication technologies for LDDRs. We actually see this as a benefit. Our work on Social Presence in Chapter 4 showed that Social Presence is a predictor of feelings of Closeness. It is thus reasonable to argue that the concept of Social Presence is linked to other relational phenomena within the context of emotional connectedness which better reflects people's real world relationships. Although our case study participants discussed the impact of the device in terms of how they felt whilst using the device, that is in terms of SP, they also related the device to their relationship more generally, in terms more akin to feelings of Closeness.

Within the case studies, we established that the devices were associated with different levels of Social Presence when compared across the different case studies. HotHugs and doodleMessenger were associated with levels of SP that ranked just below being face-to-face. SleepyWhispers and hotMitts were associated with more moderate levels of SP, similar to those scores recorded for conversations on the telephone. However, the Magic Sock Drawer was somewhat unique in that there was minimal differences in Social Presence scores across communication technologies

and so comparisons are less clear cut. These results help to shed light on our third research question:

> **RQ3: Do novel designs for devices based on the design facets from RQ2 engender positive feelings of emotional connectedness?**

We consider the success of the devices in supporting LDDRs beyond feelings of Social Presence in Section 11.3.

The theme of 'connecting' partners ran throughout the case studies indicating that although participants lacked the vocabulary of Social Presence, the motivation behind it – increasing the salience between interlocutors – is of importance to LDDRs. This has practical implications in that it further supports the idea that Social Presence measures can contribute to the assessment of communication technologies to support LDDRs. It is also a methodological contribution in that it indicates that using Semantic Differentials as a measure of communication success within relationships can occur outside of the lab. We are not aware of any work which has previously considered using Semantic Differentials outside of the laboratory setting.

Having detailed the conclusions which can be drawn and the contribution this thesis makes in terms of Social Presence, we move on to discuss the contribution the devices we developed to support for LDDRs make for the state of the art.

11.3 Devices to support LDDRs

The second major theme of this thesis was the devices we developed. As a brief recap, there were seven devices in total. The MSD and doodleMessenger were both based around sharing notes. hotHugs was based around hugging, sleepyWhispers took pillow talk as it's design inspiration. YourGloves, hotHands and hotMitts were each based on exploring the metaphor behind holding hands.

These devices are themselves a contribution. In theoretical terms they demonstrate that communication technologies can be developed which take their inspiration from the mimicry of co-located behaviours. In Section 2.8 we outline how the majority of past projects have focussed on the development of devices based on augmenting artefacts. We moved on in Section 2.8.5 to analyse what prior work had investigated in terms of behaviour-based communication technologies, arguing that the majority focussed around note-sharing. The MSD builds on this work be focussing on the production of a tangible note, moving away from the digital messages that systems such as HomeNote [Sellen et al., 2006b] and Hermes@Home [Saslis-Lagoudakis et al., 2006]. In contrast, doodleMessenger retains the digital nature of the notes but focusses on the peculiarities of trying to make such a system suitable for mobile devices.

The other behaviour which some researchers have been interested in is hugging. DiSalvo et al. [2003] and Gemperle et al. [2003] both present the design of a hugging cushion whilst Mueller et al. [2005] presents the design of an air-inflatable hugging vest. hotHugs was designed to overcome some of the practical difficulties with the inflatable vest by changing the sensory media used to heat.

Although some work has focussed on augmenting beds (e.g. [Goodman and Misilim, 2003, Dodge, 1997]) sleepyWhispers is the only system that we know of which considers pillow talk as it's underlying metaphor.

Finally, although probes have been carried out to investigate the desirability of a handholding device [O'Brien and Mueller, 2006], our three prototypes are novel in that they demonstrate the different forms such a device could take.

The synchronous devices appear to be more suited to generate feelings of Social Presence given that they focus on the in-use feelings. In comparison, the asynchronous devices are better placed to engender a sense of Closeness given the ability to reflect and think upon the notes which are received.

In theoretical terms then, our devices demonstrate that behavioural-mimicry can be used as a design guideline for communication technologies for LDDRs. To make this meaningful, we have to consider the two distinct practical contributions these devices make. The first practical contribution is that we actually built the devices; the instructions for constructing them are available and other researchers can take our designs, evaluate them or extend them in new ways.

The second practical contribution is the assessment of our third research question:

> **RQ3: Do novel designs for devices based on the design facets from RQ2 engender positive feelings of emotional connectedness?**

This is in some ways more important; although we have demonstrated that it is possible to build devices based on the mimicry of co-located behaviours, what we are actually attempting to achieve is the design of devices which help support LDDRs. In Section 11.2 we noted that compared with other conventional communication technologies, our devices scored reasonably high levels of Social Presence, generally comparable to using the telephone. Our case studies go further than this, considering the qualitative responses our participants gave having used the devices over an extended period of time.

Beyond the importance of routine, which we will discuss in Section 11.5, we noted that our messaging technologies (doodleMessenger, sleepyWhispers and the MSD) were predominantly used to exchange fun messages, based around humour or personal idioms. Our synchronous technologies were used more for forming emotional connections. For example, hotHands was used exclusively to repair the couple's relationship after arguments had occurred, while hotHugs was used as a replacement mechanism for touching one another, forming an emotional bond. In general, all of our case study participants stated that although they enjoyed the use of the technologies and made them feel more connected to their partner, they didn't believe that the devices would have any long-term relational impact. Although this is disappointing, perhaps this result is good enough; supporting LDDRs is a substantial challenge and if our devices have a positive effect when they are used, this has got to be considered a success. Therefore we have positively answered RQ3 – our devices *did* engender positive feelings of emotional connectedness.

Moving on from the specifics of the devices, we should reflect on the design process used, considering what worked well and what added little when creating the devices. In Section 5.1 we were clear that this thesis was not about design processes. We argued against the process of

design as a rational problem solving process because design as a process of reflection-in-action better suited the ill-defined design problem of how to design a communication device to support LDDRs. The two main sources of knowledge we used within the process was an understanding of previous designs from Section 2.8 and our stated aim of trying to develop devices based on the mimicry of co-located behaviours.

In general, we are satisfied with the design process in the sense that it produced seven devices which are both novel and in some sense 'useful' in the context of LDDRs. On reflection we would have brought in more information regarding the behaviours the co-located couples perform. This information was not utilised within the design process in any structured form. Indeed, determining what the range of behaviours are, how prevalent they are and how they manage to connect LDDRs together is information which would have theoretical implications beyond being useful for our design process. In addition, we would argue that we limited our design process, being too concerned with the practicalities of constructing the device, at the expense of more radical and innovative design. Although this was practical within the context of the thesis, a number of behavioural metaphors were considered (kissing being the main one) which were not developed as it was unclear how we could build a device based on them. Furthermore, our devices may have taken different forms had we access to more knowledge and experience around how to construct physical communication systems.

The construction of working prototypes was an important aspect of this thesis. The utility of working devices has a substantial methodological impact as compared to a purely design focussed thesis which could have focussed on design sketches. The difference is that although this thesis has constructed less innovative devices than those which could have been designed, we have been able to deploy the devices into couples' relationships which provides us with a better understanding of how our devices operate in the 'real world'. That said, the devices were only constructed to a prototype standard; although they worked, the standard of finish was not high. We need to reflect on the low-fidelity nature of the prototypes and whether this affected the results of this thesis.

Within the interview studies (see Chapter 6) our methodology utilised scenarios such that participants became familiar with the design concept before approaching the prototype. Thus our discussion with participants focussed more on the general design themes than on the shortcomings of the prototypes. We would argue that this was a sensible methodological mechanism for ensuring that participants were providing information on the high level themes whilst still utilising the prototypes to provide a grounded experience of what the design concept would be realised as.

Within the case studies, our experience is that it was generally positive to be using prototype devices. It was made clear to all of our participants that the devices were prototypes and would likely have shortcomings. This meant that our participants were more willing to criticise and discuss/explore the devices as they understood that they were not finished concepts but a method of externalising our design concepts. We believe that if the prototypes had been finished to a higher standard, our participants may have been less willing to engage with the design thinking that the devices represented.

On a practical level, within the MSD case study, the technical shortcomings of the prototype led to limitations in the detail of the data we collected. On a more positive note, this was the only case study which suffered from major technical difficulties meaning that in the context of this

thesis, the prototype nature of the devices was not a major limitation in gathering meaningful data.

11.4 The Design Space

The theme which underpins much of this thesis is the design space. In Section 5.4 we stated that we were developing a conceptual design space which have been defined as encompassing "all the possible design solutions" for a given problem [Westerlund, 2005]. Each facet within the design space adds a dimension which describes a particular characteristic of a device.

Our design space began as a series of themes developed from a set of general medium-based questions to prompt free-text responses about the various communication media people use within their relationship, completed as part of the study which aimed at defining Social Presence, presented in Chapter 4. This evolved as we brought in concepts from the literature (see Chapter 2) and reflected upon the design decisions which were confronted in the creation of our devices within Chapter 5. This resulted in an initial design space, presented in Section 5.4. We then moved on within our interview studies to analyse our design prototypes, particularly with reference to their design characteristics. This resulted in the refined design space presented within Section 6.4. The set of facets included within the revised design space consists of:

1. Metaphor of use
2. Personalisation
3. Effort
4. Sensory Medium
5. Fleeting versus Realised Output
6. Openness of the System
7. Synchrony
8. Reciprocity
9. Serendipity and anticipation
10. Availability

This design space represents our answer to our second research question of:

> **RQ2: What design facets are significant when considering the design of communication technologies for long distance dating relationships?**

It is worth comparing our design space to the strategies proposed by Hassenzahl et al. [2012]. This is the only attempt we are aware of which attempts to create a design space for communication technologies for inter-personal relationships.

Hassenzahl et al. have a different focus to us, moving beyond LDDRs and Social Presence to consider all close inter-personal relationships and relatedness. Their proposed strategies are

based on an analysis of how 143 published designs aim to fulfil the need for relatedness. These strategies are awareness, expressivity, physicalness, gift-giving, joint action and memory. There are some differences between our design space and the strategies proposed by Hassenzahl et al. beyond our different focuses. We should first note that whilst our design space is based on the literature and a series of studies exploring the relevance of the facets to LDDRs, the Hassenzahl themes are only based on the literature. This is a limitation as we have previously observed how many of these designs are never evaluated, meaning we have limited data supporting their themes. The Hassenzahl themes also have a different focus to us, attempting to determine how to generate a 'good' design rather than mapping the conceptual space of relationally meaningful devices.

While we have focussed on specific design properties of technologies, the fact that Hassenzahl considers broad design strategies means that awareness and gift-giving, both of which we have previously discussed, are included. While we have noted their importance, neither of these strategies can be classed as properties of a given technology as they are also based on how people use said technology. Similarly, joint action is an aspect of synchrony but also considers how people would appropriate and use a given technology. The concepts of expressiveness and physicalness are both subsumed in our design space into the facet of sensory media which is the means through which these strategies are achieved. The final strategy, memories, is something we have considered including in the design space but noted that it is not clear how you actually design communication technologies which support the reflection of memories. In summary then, while there are overlaps between our design space and Hassenzahl's strategies, we focus on the exact properties of communication devices rather than the broader strategies of how 'relatedness' can be achieved through communication.

Moving on, we need to consider some of the characteristics of this design space, namely the completeness, correctness, necessity, sufficiency and utility of the various facets. We deemed these characteristics to be important based on the literature regarding design spaces [Aghaee et al., 2012, Graham et al., 2000, Jul, 2002, Moore, 1997, Lane, 1990].

We have made clear throughout this thesis that we do not claim that our design space is complete. We have only included facets which we have either extracted from the literature or had revealed through our studies. This is to ensure that we maintain the correctness of the design space by having a strong evidential basis for including the facets within the design space. This evidence comes from repeatedly analysing our data for evidence to support the themes we have already included within the design space as well as establishing new ones. Thus we developed an initial set of themes from our study analysing the definition of Social Presence (see Chapter 4), analysed the existing set of communication technologies from the literature (see Chapter 2) before considering these concepts through the process of designing our devices (see Chapter 5). This resulted in an initial design space which we analysed through a series of interview studies (see Chapter 6) which resulted in a refined version of the design space. We then ensured that these themes held meaning to couples' in LDDRs within our case studies (see Chapter 9). We have no doubt that there are additional concepts which could be added to the design space but without any evidence to indicate that the facet is correct, we have decided to err on the side of caution.

As a case in point; let us reflect on delimiting the edges of the design space and the non-inclusion of the concept of evocativeness. Discussed within the interview studies, we defined evocativeness as "the quality of being evocative; a tendency to evoke memories, feelings" [Oxford

University Press, Accessed May 2012]. In a number of cases, the devices caused people to remember a significant moment within their relationship and a subsequent visceral attachment to the device. These personal memories made using the device much more pleasant. We hypothesised that devices based on such memories would create stronger connections between the participants. Although we recognise the importance of memories in relationships, we argued that the difficulties around knowing how to stimulate particular memories meant that we did not include evocativeness in the design space. We collected no data from the case studies to suggest we should change this position. We would argue that it is more important to know that the facets within the design space are correct even if this leads to an incomplete space, limiting the innovation which can be derived from the design space.

There are two further concepts to discuss; necessity and sufficiency. There is a difference between those dimensions; distinguishing between those facets which are necessary for achieving some purpose and whether a design space is sufficient to arrive at some result. In terms of our design space, we have demonstrated sufficiency through describing how the design space underpins our devices. Through the case studies we demonstrated that these devices helped to support LDDRs. This indicates that the design space is sufficiently rich for designing communication technologies to support LDDRs. However, necessity implies that we ascribe value judgements to the facets, defining which ones are needed to create a design to support LDDRs. We have already stated that this thesis does not aim to ascribe value judgements to the design facets. This means that we cannot definitively state which of the design facets are necessary and which are not. However, our experience of designing the devices, which were found to support LDDRs, indicates that all of the facets are necessary though we have no evidence to support such a claim. It is possible that some facets are not necessary for certain sub-types of LDDRs (such as those which were co-located before becoming distant). It is also possible that decisions on certain facets (such as synchrony) necessitate certain decisions on other facets (such as sensory media). Both of these possibilities are left as elements of further work.

Finally, considering utility, our conceptual design space has both a theoretical and a practical contribution. In practical terms, designers can use the space to foster innovation when creating new designs. Design spaces result in a "descriptive and exploratory tool for designers and to communicate and record their reasoning about potential interactive systems" [Graham et al., 2000, p. 406]. This is essentially a practical contribution; designers can examine the design space and consider where they want to make cutting-edge changes.

From a theoretical perspective, the comprehensive consideration of the various dimensions provides researchers with a novel design-centric view over the state of the art. This scopes out areas where further innovation could occur. As Graham et al. [2000] argue, by formalising the design space in this way, it becomes easier to consider alternative designs and the properties they could have.

In addition to our consideration of the design space as a whole, we should reflect on some particularities of some specific facets. The first of these is what is the theoretical end-point of what a totally 'Closed' technology would mean. A totally open technology is clear – anyone can communicate with you and you can communicate with anyone else. We have described one-to-one communication as being 'closed' but from a theoretical perspective this is not the end point. The question to ask is whether it is possible to conceive of a communication act which has no receiver? Could we consider a system based around self-reflection (e.g. a diary with your future self) to be a completely closed communication system? It is a communication

system only in the sense that you are communicating with a future version of yourself. This is only really interesting from a theoretical perspective as it is difficult to conceive of how a system such as this would be useful in supporting LDDRs.

The second facet to discuss is sensory media and the 'specialness' of touch as a sensory media within LDDRs. All of the data collected within this thesis supports this perspective, particularly as it appears that touch is an important element which is missing from distant relationships. The dearth of devices which utilise touch as a channel of communication is a limitation of the current state of the art, particularly given that others have argued that heat is a suitable interaction medium for exchanging emotion [Lee and Lim, 2010]. We believe that the inclusion of touch within the design space should encourage others to consider using it as a channel of communication.

The penultimate facet to focus on is effort. When we introduced effort in Section 5.4 we argued that the investment of effort must be meaningful rather than wasted for it to be valued – making someone solve sums before sending an email is not the same as encouraging people to handwrite a letter. Within this thesis, all of the opportunities for investing effort have focussed around personalisation. For example, doodleMessenger encourages the investment of time in creating meaningful drawings; hotHugs in the decoration of the belt and sleepyWhispers in the recording of the messages. We have distinguished effort from personalisation because we do believe they are distinct concepts. As an example of the investment of meaningful effort beyond personalisation, let us consider a hotMitts where actually creating the device is effortful, independent of the personalisation element of the co-creation process. As an example of a personalised system, let us consider a system which replaces typed text with a digital recreation of their handwriting. Such a system would create personalised messages *without* the investment of meaningful effort. We believe that it is important in further work to determine whether the investment of effort in the creation of communication messages can be achieved independently of personalisation. If not, effort needs to be subsumed into the personalisation facet within the design space.

In Section 11.3 we discussed how our case studies failed to demonstrate that the devices have an impact beyond the specific act of communication. We proposed running some extremely long studies (around a year) to fully understand how communication technologies integrate into couples' long term relationship. This necessitates a consideration of how surprise can be maintained in the long-term as the device becomes part of the couple's routine. Surprise is distinct from novelty in that we believe that it can be maintained. We think that surprise can be split into two types; temporal surprise where messages are found at serendipitous times and purpose surprise where messages are created which subvert the form that the communication system is designed to produce. Although we believe that both of these forms of surprise can be maintained in the long term – as people reporting on receiving snail mail have indicated [Kelly and Gooch, 2012] – this remains an element of further work.

Having discussed the major outcomes of the project we now turn our attention to considering the methodological process undertaken within this thesis.

11.5 Methodological Reflections

In Chapter 3 we laid out the broad methodological standpoint of this thesis. To revisit our discussions, we first considered what type of research methods to utilise before discussing the specific measure of Social Presence to use and then finally which approach to take towards our qualitative data.

Let us first consider the research methods utilised within this thesis. We argued that our research questions are based in an area of human activity where experimental investigation has little advantage as a methodological technique. There is so much context surrounding each communicative act that isolating them in a lab setting is unlikely to be revealing. Furthermore, an experimental setting would likely be too artificial to reflect the true communication practices of participants whilst introducing unwanted influences due to the unfamiliar setting. The relational sphere of human activity is, furthermore, largely about subjective meanings, attitudes and feelings rather than transparent communication activity. Such a position is supported by other work in this area (e.g. [Sedikides et al., 1999, Stafford et al., 2006, Stafford and Reske, 1990, Stafford and Merolla, 2007, Le et al., 2011, Pistole et al., 2010, Dainton and Aylor, 2002, Brown et al., 2009, Kaye and Taylor, 2006, Crabtree et al., 2009]). We concluded that by using multiple techniques to study a single issue (specifically diary studies, questionnaires and interviews) we could triangulate the data, to ensure that our analyses and conclusions are not biased by the flaws of a single technique.

We should reflect on whether the studies within this thesis support the arguments we made in Chapter 3. Taking the decision to focus on non-experimental methods first, our data and analyses suggest that this was the correct decision. Our exploration of Social Presence (Chapter 4) and the case studies (Chapter 9) both showed that feelings of Social Presence are based on a large amount of context which is lost within an experimental setting and which better reflect peoples' actual use of communication media. This context is also hidden by relying on Social Presence ratings alone; we can only gather this contextual information through qualitative techniques. As a simple example, the impact that 'tiredness' had on pZ's feelings of Social Presence within the sleepyWhispers case study (see Chapter 9.4) would not have been established with a laboratory.

This is not to say that experiments are not a valid technique within the research area of Social Presence. If the valence/intensity concept of Social Presence is taken forward, we would anticipate an experimental set-up to investigate the idea and to establish and validate a new measure of Social Presence. We simply argue that when considering Social Presence within the context of people's lives (such as when assessing new communication technologies) it is advantageous to use research methods which place the technology within peoples' daily lives.

Reflecting on how we triangulated the research methods, using both interviews and the case study diaries did combine to provide different viewpoints across the design process. The results of the case studies suggests that focused exposure to design prototypes is an important complementary technique for exploring the potential of alternative ideas. However, we would argue that long-term trials are not the only or the best method of looking across the design problem. Although our field trials reveal information about actual use, it is difficult to tease out general elements of a design concept from immersion in the detail of everyday experience. In the interview studies (see Chapter 6) our aim was not to collect information on how participants used our devices but to use the devices as embodied artefacts to explore design themes

in LDDRs. Field trials are not intended to collect this type of information whereas guided interviews are. Therefore it is not a question of which is the best method to use to research the design concepts embedded within the devices. Both the interview study and the case studies revealed different aspects of the design problem; the interviews considering the question of design independently of their lived experience whilst the case studies consider the design problem from the perspective of their daily lives. The case studies also give a more rounded evaluation of how successful the devices are in supporting the couple's relationship compared to other communication devices.

Focussing on the case studies, we should query whether multi-participant studies would provide any additional insights that our case studies don't. There are obvious advantages in terms of how applicable our analyses and conclusions would be if we had studied the devices within multiple relationships. This decision was essentially a pragmatic one; within the bounded resources of this thesis, we decided to study our five main devices in a manner which gathered a deep and rich understanding of the couple's relationship, communication ecology and the way in which they used the device under investigation. We would position repeating our case studies with multiple participants as a piece of further work which would contribute an understanding of how widely applicable the conclusions of this thesis are.

Beyond the number of participants who used the devices, the case studies have additional limitations which should be considered. Diaries as a research method allow us to develop data about communication habits over time, important for established participants' routines, but the effort involved in completing the diaries is very high. We made attempts to lessen the effort involved by minimising the data collected on each diary entry; however, in some cases the effort involved was too high for our participants to be motivated to complete their diaries. Our sleepyWhispers participants did not complete their Daily Diaries; our MSD participants also completed single diaries, pC completing the Contact Diary and pR the Daily Diary. Although our doodleMessenger participants completed both diaries they did comment that they were particularly effortful. It is notable that neither of the couples who failed to complete their diaries received a financial incentive. As a minor practical contribution then, we would argue that a meaningful incentive is necessary to motivate the completion of effortful diaries.

The effort involved in completing the diaries directly impacted the quality of the responses the case studies gathered with regards to appreciation, conversation topic and feelings. Participants were aware that these were not the primary focus of the case studies and as such did not provide responses which were rich enough for a meaningful in-depth analysis. This indicates that we tried to gather too much data from the case studies and should instead have focussed on our key questions.

We should not forget that the type of information gathered through using diaries in the case studies was essential in terms of gathering information about couples' communication routines. This data could not be easily gathered through any other technique. In Chapter 10 we highlighted how significant routines were to our participants, arguing that couples' communication routines are more than mechanisms of convenience; a way of regulating the times and media used to communicate. Our participants described their communication routines in a way that ascribed them more meaning than this. Not only is it about convenience, a couple's routine appears to be somewhat akin to a personal idiom in that the routine itself has emotional meaning. This has methodological, practical and theoretical contributions. In methodological terms, the significance of couples' routines means that researchers interested in investigating communica-

tion devices should ensure that they use research methods which contain the ability to examine people's routines. Practically, the importance of routine has two interpretations. The first is that building devices which complement people's existing routine, by providing an additional channel of communication to a pre-existing device, not only increases the probability that the device will be used but could also increase the emotional meaning of using the pre-existing device. The second interpretation is that prior to designing a new device, it is necessary to understand where LDDRs feel that there is a gap in their existing routine. By designing a device which could be used to fill that gap, the likelihood of the device being adopted is increased. Theoretically there appears to be an element of further work here. Although we have suggested that our participants' ascribed emotional value to their routine, our studies were not designed to explore this concept. We encourage others to explore whether this concept is meaningful as it would change our understanding of how couples communicate.

Moving on from the discussion of research measures, we should reflect on our decision to use the Semantic Differentials measure of Social Presence. We selected this measure as it had been used by other researchers (e.g. [Hauber et al., 2006, 2005]) and had sufficient validation and verification for our purposes. A number of participants reported that they found it difficult to use the measure as they couldn't understand the connection between the terms used and their use of communication technologies. 'Large' and 'Small' in particular were hard to relate to their relationship. Despite this difficulty, the measure appears to have been robust enough. The analyses from our studies have reveal no clear differences between the results from the Semantic Differentials measure and the qualitative data. Similarly, the studies have not resulted in any data which we could not construct a theory to explain it, suggesting that the data gathered is reasonable. It is also worth noting that difficult as Semantic Differentials was to use, the alternative measures would have been no better; being too long (The Networked Minds measure [Biocca et al., 2001, Int, 2002] asks 38 probing questions) or technology specific.

When considering the qualitative analysis technique to use within this thesis we discussed grounded theory, IPA and thematic analysis, deciding to use thematic analysis. Although we are content that thematic analysis was suitable for revealing interesting themes within our data set, it is necessary to consider the methods we used to validate our findings. Beyond making it clear that our analysis is intensely personal, we also triangulated our data across several studies. We are also confident enough in our analysis to produce an online 'paper trail', available online at `http://people.bath.ac.uk/dg216/audit`. All names which appear in the files have been changed. Those documents where anonymization would be too complicated (for example, in the Case Study diaries completed for Part 2 of this thesis) are not included but are available on request. This is one method to give other researchers and the public access to the material to avoid questions of falsification or academic collusion. Of more concern is whether participant feedback was sufficient to ensure some sense of validity from our analyses. Although we circulated our analysis of the data to the relevant participants, we received no feedback from any of our participants. This could be interpreted as all of our participants being completely content with the analysis we provided; it could also be interpreted that our participants did not care about the analysis we'd made. This is a weakness in some sense as it provides us no validation that our participants agree with the analysis or conclusions we've drawn from the data they have provided. As a challenge for further work then, we would encourage others to explore ways of motivating participants to provide feedback on researcher's analyses.

The final methodological concept we need to discuss is how we have combined our qualitative

and quantitative data to form an understanding of couples' relationships and use of communication technologies. Within this thesis we used the term 'emotional connectedness' as a means of combining Social Presence data with qualitative data. We made it clear that the term, unlike Social Presence and Closeness, is not a specific concept from the literature, being a descriptive term rather than an operationalised scale. We also made it clear that we do not use the term to create a new concept for use in the literature; instead we are trying to formulate a way of using both quantitative and qualitative data to inform our understanding of a relationship. This is a methodological contribution for two reasons. As discussed in Section 2.4, Social Presence is not normally considered alongside qualitative data. Additionally, as discussed in Section 2.8, when communication technologies are evaluated, they are generally not assessed in quantitative terms. This is a shortcoming in the current state-of-the art as both types of data are useful in answering different questions in a complementary fashion, as demonstrated by this thesis.

In general, we would argue that combining qualitative and quantitative data can be difficult as they involve distinct skill sets which are not traditionally held by an individual researcher. However, reflecting on the outcomes of this thesis we would also argue that it is beneficial as the different types of data reflect different interests. Our Social Presence data has provided an assessment of a given technology within the context of a specific communicative act whilst our qualitative interviews revealed themes about *why* different design decisions affected their experience of communication technologies. Our qualitative data also assists us in understanding our Social Presence data. When graphing the Social Presence data collected within the case studies, the qualitative responses in the diaries assisted us in explaining why certain data points were anomalously high or low (e.g. tiredness). This is a good example of the two type of data combining to provide a richer understanding than either type of data would on it's own.

We have now considered the four main themes within this thesis (defining Social Presence, the development of our devices, the design space and our methodological approach). We have considered what the main contributions are that this thesis makes in each of these areas and discussed what elements of further work would extend the state of the art even further. We now move on to some broad remarks which conclude this thesis.

11.6 Further Work

There are three main areas of further work, based on our interest in Social Presence, the devices we developed and the design space. Within this section we discuss how our thesis raises a number of areas which we would like to explore as further work.

In terms of Social Presence this thesis proposes two main areas of further work. The first regards our conception of Social Presence. Although we have found some evidence to support the argument that various media and user characteristics impact feelings of SP, there is an issue that our work raises as being potentially interesting. The issue concerns the independence of emotional valence (i.e. positive or negative) and intensity (i.e. strength of feeling) and how they relate to Social Presence. Throughout this thesis we have treated high levels of Social Presence as a uniformly positive contribution to a LDDR communication experience. This is not an unreasonable position to take given the association we've found between Social Presence and Closeness. However, this is not the only position which could be taken. Some types of relational encounter, such as a heated argument, might be highly Socially Present in terms of

intensity but very negative for the relationship. This reflects concerns which have been found in conflict resolution [Billings and Watts, 2007]. The same valence problem does not appear to apply to Closeness and IoS but that scale in itself is at a level of remove from the act of communicating. It is worth considering the valence problem – it is easy to think of a couple having a raging argument making them feel extremely socially present but in a negative way. If this is the case, the entire way we think about Social Presence would change – as would the measurement techniques which are currently available. Also, within the time course of a relationship, the resolution of an argument may result in stronger positive feelings than any that had preceded the argument.

Given the significance of this issue it is necessary to explain the reasons we did not pursue this research direction. The first is that this thesis is concerned with communication technologies and the best way to design them to support long distance dating relationships. Our work on Social Presence has been intended to operationalise it in such a way that would be useful for that goal – hence the focus on understanding people's current communication habits, the factors that influence people's use of technology and those factors (medium, relationship type and relationship distance) which impact Social Presence and it's connection through communication technologies to LDDRs. It is not clear how investigating the valence question would further this cause. Secondly, if valence and strength were found to be separate elements of the concept of Social Presence, all measurement techniques we currently have would have questionable validity. Given the already uncertain nature of the measures (see Section 3.2), abandoning them would have significantly restricted the available methods of investigation. Combined with our focus on communication technologies and Long Distance Relationships, we leave the question of valence and intensity as an open issue.

This relates to the second piece of further work relating to Social Presence; how to measure it. It is worth reflecting on what is the meaning of Social Presence as distinct from the Semantic Differentials measure. We would argue that although such concepts exist in theoretical terms, we can only discuss them in terms of their measurements. For example, meters are only defined by the form in which they are measured. This thesis has produced evidence that the concept of Social Presence is meaningful within the context of LDDRs as measured through the Semantic Differentials measure.

As an element of further work, it would be useful to have a reliable, verified method of assessing Social Presence which was also meaningful to participants. This was not explored within this thesis as our focus has been on the development of devices to support LDDRs. Additionally, if our understanding of Social Presence changes to consist of a separation between valence and intensity, as we have suggested, new measures will need to be developed to address this theoretical development.

The final area of further work regarding Social Presence regards the relationship between SP and other relational phenomena. In Chapter 4 we used the metaphor of affective experience to help explain our model of Social Presence and Closeness. We noted that **emotions** are object-directed, short-term and involve a relationship with a particular object. **Moods** are not directed at objects and tend to be more general. Moods are more enduring than emotions though the concepts are related; a person's mood biases the emotions they experience and a person's emotions contribute to the mood they are in. There is a further distinction with the long-term concept of **sentiment** towards an object which is based on expectations from accumulated direct experiences, generalization or social learning. We argued that, in the terms

of this metaphor emotions are similar to SP and sentiments are more akin to Closeness.

This comparison was intended to assist in understanding the connection we proposed between Social Presence and Closeness. We now raise the possibility that this link could exist in a direct as well as metaphorical form. What we mean by this is that a person's emotions could have a direct impact on feelings of Social Presence (but perhaps not Closeness) whereas someone's sentiment could have a direct relationship to feelings of Closeness (but not Social Presence). We also hypothesise that Social Presence is not only related to Closeness but also other relational phenomena such as empathy, intimacy or emotional intelligence. Attempts were made to link Social Presence to some of these concepts within the case studies, considering appreciation, conversation topic and emotion.

Let us now consider the devices we developed. The first thing we should note is that although our devices were evaluated over a reasonable length of time (four weeks), this can not be considered 'long term' within the context of a couple's relationship. As an element of further work then, we return to the idea of running evaluations of these devices over the course of several months. This would involve a high degree of logistical support and highly motivated participants. However, it would allow us to reflect on two areas which our work cannot. The first of these is how couples' use of the devices changes as the novelty effect of having the device is mitigated over time. The second is to better understand whether the repeated positive sense of connection engendered when the device is being used contributes to a longer-term sense of connection which supports the couple more generally.

As an additional piece of further work, we should consider the different directions in which the development of further devices could be taken. It is clear from the size of the design space we have presented (see Section 6.4) that there are many areas which could be explored.

The first direction of exploration should focus on using different behaviours as the underlying metaphor of the device. There remain a number of key relational behaviours which have thus far been under explored including kissing ([Samani et al., 2012]), sex ([Brewer et al., 2006]), cuddling and other types of routine behaviour such as going to places together or playing games together. One opportunity for exploring how to connect couples wanted to have a sense of 'shared experiences' would be to focus on the creation of shared virtual places which hold relational meaning to the couple. A large amount of work within the telepresence field has looked into how to turn a shared space into a shared place which could be utilised for the purposes of enhancing Social Presence [Turner and Turner, 2004a, 2006, 2004b].

There is also space to explore different sensory media. We have focussed on a small sub-set of tangible interaction techniques, particularly heat. Other tangible techniques such as body position, touch and pressure could also be utilised. Broadening the scope, we also see smell as an under-researched sense, particularly within LDDRs. Although inStink utilised smell as a channel of communication [Kaye, 2004, 2000], we believe there is an opportunity to further explore the use of smell as a means to communicate.

Our final area of further work regarding the devices is to consider how applicable our devices could be to other relationships.

In Section 2.3.2 we discussed some of the limitations in the area of LDDR research which have previously been acknowledged (see [Stafford, 2005]). Much of the work in this area focusses on young, white, middle-class heterosexual couples and does not consider cross-national relationships. Our work does not correct for these limitations – the bias of using University students

(for the reasons we've discussed in Section 2.3.2) tends to introduce these limitations through the typical population of a UK University. As a piece of further work it would be interesting to see if our results and conclusions apply across these different types of LDDRs. For example, we could explore whether cultural-specific behaviours (such as Eskimo kisses) have a greater relational impact than devices based on generic relational behaviours.

In Chapter 4 we also found that Social Presence is meaningful in personal relationships beyond long-distance dating relationships. Specifically we considered parents, friends and siblings. We think it would be an interesting piece of further work to examine the meaning of Social Presence and our devices within marriage, friendship, employment and family to ensure that all of our personal relationships are supported by the communication devices they use.

The final area of further work refers to the design space we have constructed.

The first element of this regards the fact that conceptual spaces (as we described) are not the only type of design space which exist. We also discussed *generative* design spaces which assist designers in producing designs which are 'good' for some measure of good. Generative spaces seek to predict what design elements and characteristics will produce a positive outcome. In comparison, *evaluative* design spaces predict the outcome that a given design would produce [Jul, 2002, Moore, 1997]. Generative and evaluative spaces are very similar in that both apply value judgements to the design facets within the design space. They differ in that a generative space starts with a design space and results in the design of a device. An evaluative space starts with a design space *and* a device and results in an assessment of whether the device is in some sense 'good'.

It is possible to turn a conceptual design space into a generative design space by formulating "design rules that indicate good and bad combinations of choices. Such rules can be used to select an appropriate system design based on functional requirements" [Lane, 1990, p. 1]. Similar rules would be necessary to turn a conceptual design space into an evaluative design space. Creating such rules was beyond the scope of this thesis. Although we have some idea of what the general heuristics could be (e.g. we found personalisation was generally a good facet to have), we have placed no value judgements on the facets per se. An important element of further work then is to develop design rules which combine with our conceptual design space to create a generative and evaluative design space for the creation of devices to support LDDRs.

There remain two main elements of further work. The first is exploring what additional facets should be included in the design space. We have been conservative in only including facets which we have a substantial amount of evidence for. Undoubtedly there are other facets which could be useful for designers creating devices to help support LDDRs. Finally, we have already explored some of the peculiarities of specific facets in Section 11.4.

11.7 Concluding Remarks

This thesis sought to address the lack of understanding in how Social Presence could be used to support long distance dating relationships. It used the phenomenon of Social Presence as a lens for evaluating existing communication technologies and a measure of how comparatively successful our devices are within LDDRs. Furthermore it argues that communication devices based on the mimicry of co-located behaviours are an under explored research area which could support distant lovers.

The main contribution of this thesis is an understanding of the design features of these devices which contribute to a sense of emotional connectedness which assists long distance lovers in maintaining their relationship. Furthermore it contributes seven devices which exemplify these factors and demonstrate how co-located behaviours can be used as the underlying metaphor for communication devices. It also provides an understanding of how Social Presence operates differently within long distance dating couples compared to other relationship types and distances. Finally it provides a methodological understanding of how to use Social Presence alongside qualitative techniques to assess how successful a communication technology is in supporting long distance dating relationships.

Hopefully, this thesis will inspire others to develop devices based on the mimicry of co-located behaviours. We hope that our design space will provide a resource for those researchers who are interested in our ideas and that the design space itself becomes improved and extended to be applied across a wider range of devices and contexts. We look forward to a time where distance need no longer be a barrier to maintaining close intimate relationships due to the communication technologies the couple can utilise in supporting their bond.

Part IV

Ending Material

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Appendix A

Literature Review 2: Devices to Support Social Presence Supporting Material

Device	Personalisation	Effort	Sensory Media	Metaphor
Feather, Scent and Shaker ([Strong and Gaver, 1996, Gaver, 2002])	In the selection of scent	Low	Sight, smell and touch respectively	Abstract
Earmuffs ([Gaver, 2002])	In the selection of muffs	Low	Touch	Abstract
Kiss ([Gaver, 2002])	Selection of light patterns	Low	Sight	Behaviour
inTouch ([Brave and Dahley, 1997])	No	Low	Touch	Abstract
Virtual Intimate Object ([Kaye et al., 2005, Kaye, 2006, 2005a,b])	No	Low	Sight	Abstract
inStink ([Kaye, 2000, 2004])	No, but could be if other non-spice smells were used	Low	Smell	Abstract, meaning interpreted from smell
inTouch ([Hindus et al., 2001])	Selection of token and signal	Low	Changeable	Abstract

Continued on next page

Table A.1 – continued from previous page

Device	**Personalisation**	**Effort**	**Sensory Media**	**Metaphor**
Love Egg ([Kaye and Goulding, 2004])	Uses voice	Low	Sound and movement	Somewhat abstract
Hand-holding ([Kaye and Goulding, 2004])	Uses a handprint	Low	Touch	Behaviour
The Bed ([Dodge, 1997])	No	Low	Sight and touch	Abstract
The Sensing Beds ([Goodman and Misilim, 2003])	No	Low	Touch	Artefact
Ruug [Thompson et al., 2005])	No	Low	Sight	Artefact
ComSlipper ([Chen et al., 2006])	Choice of slippers	Low	Sight and touch	Artefact
Habitat ([Patel and Agamanolis, 2003])	Yes, in the selection of tagged objects	Low	Sight	Artefact
SyncDecor ([Tsujita et al., 2008])	No	Low	Sight	Artefact
Lover's Cups ([Chung et al., 2006])	No	Low	Touch	Artefact and Behaviour
TSUNAGARI ([Itoh et al., 2002])	No	Low	Sight	Artefact and Behaviour
Digital Family Portraits ([Mynatt et al., 2001, Rowan and Mynatt, 2005])	No	Low	Sight	Artefact
The Hug ([DiSalvo et al., 2003, Gemperle et al., 2003])	No	Low	Sight and sound	Behaviour

Continued on next page

Table A.1 – continued from previous page

Device	**Personalisation**	**Effort**	**Sensory Media**	**Metaphor**
Hug over a distance ([Mueller et al., 2005])	Potentially through the selection of activation toy	Low	Touch	Behaviour
Gustbowl ([van der Hoog et al., 2004])	No	Low	Sight	Ritual behaviour
Social Radio ([Röcker and Etter, 2007])	In terms of the music listened to	Low	Sound	Ritual behaviour
Magic Box ([Vetere et al., 2006, 2009, Davis et al., 2008])	Highly in the items which were exchanged	High in terms of the selection and production of items	All	Behaviour
HomeNote ([Sellen et al., 2006b])	Yes, through handwriting	High if invested in note creation	Sight	Behaviour
Wayve ([Lindley et al., 2010])	Yes, in the handwriting and drawing	High if invested in note creation	Sight	Behaviour
ASTRA ([Markopoulos et al., 2004, Romero et al., 2007])	Yes in handwriting and drawing	High if invested in note creation	Sight	Behaviour
Kissenger ([Samani et al., 2012])	No	Low	Touch	Behaviour
United-Pulse ([Werner et al., 2008])	Yes in so far as individual's heartbeat is intended to be used	Low	Touch	Artefact
Gumball ([Truong et al., 2004])	No	Low	Taste	Behaviour
Lover's Box ([Thieme et al., 2011])	Yes, in the video message	Can be invested in message creation	Sight and sound	Behaviour
TapTap ([Bonanni et al., 2006])	No	Low	Touch	Artefact

Continued on next page

Table A.1 – continued from previous page

Device	**Personalisation**	**Effort**	**Sensory Media**	**Metaphor**
Peek-a-drawer ([Siio et al., 2002])	Yes in the objects selected	Low	Sight	Behaviour

Table A.1: An analysis of the features of various devices designed to support intimate relationships

Appendix B

Exploring Social Presence

B.1 Diary Ethics

Closeness/Social Presence Consent Form

Study Overview

This is a study of how communication between people affects how close they feel to one another. During this study you will be working with someone you feel close to. You will be asked to record a daily rating of closeness and details of communication between the two of you. Full details are given in your briefing script.

Important Information

There are no hidden procedures and no deception is involved in this study. The data recorded include a daily rating of closeness (the **Daily Diary**) and details of your feelings about specific communication with your partner (the **Contact Diary**). All data collected during this study will be recorded such that your individual results are anonymous and cannot be traced back to you. Your results will not be passed to any third party and are not being collected for commercial reasons. The results may be published in an anonymous form.

Participation in this study does not involve physical or mental risks outside of those encountered in everyday life. You have the right to withdraw from the study at any time. If you do decide to withdraw, please inform the experimenter.

By signing this form you acknowledge that you have read the information given and understand what you are being asked to do and freely agree to participate in this study.

Name: _____ Age: _____

Gender: _____ Occupation: _____

How do you know your study partner?

How far from your study partner (in driving time) do you live?

How long have you known your study partner?

Signed: _____ Date: _____

Experimenter: Daniel Gooch, Department of Computer Science, University of Bath, Bath, BA2 7AY. D.J.Gooch@bath.ac.uk.

UNIVERSITY OF BATH

Department of Computer Science

13-POINT ETHICS CHECK LIST: Closeness/Social Presence Logbook Study

This document describes the 13 issues that need to be considered carefully before students or staff involve other people ("participants") for the collection of information as part of their project or research.

1. *Have you prepared a briefing script for volunteers?*

A briefing script has been prepared. It will be given to volunteers by both text and voice. A copy will be included in all of the logbooks. The briefing script will include details of what they will be required to do, the kind of data I will be collecting and how it will be used.

2. *Will the participants be using any non-standard hardware?*

No

3. *Is there any intentional deception of the participants?*

No

4. *How will participants voluntarily give consent?*

A consent form will be signed by all participants which will explain that the data may be published in an anonymous form.

5. *Will the participants be exposed to any risks greater than those encountered in their normal work life?*

No

6. *Are you offering any incentive to the participants?*

All participants will be entered into a prize draw for 4 prizes of £50.

7. *Are any of your participants under the age of 16?*

No

8. *Do any of your participants have an impairment that will limit their understanding or communication?*

No

9. *Are you in a position of authority or influence over any of your participants?*

I will be tutoring some of the participants but this will not be used to pressurise participants to take part.

10. Will the participants be informed that they could withdraw at any time?

This is included in the briefing script and consent form.

11. Will the participants be informed of your contact details?

Contact details are included in the briefing script and consent form.

12. Will participants be de-briefed?

A debrief will be sent to participants after receiving their completed logbooks.

13. Will the data collected from the participants be stored in an anonymous form?

Yes

NAME: Daniel Gooch

SUPERVISOR (*IF APPLICABLE):* _____

SECOND READER (IF APPLICABLE): _____

PROJECT TITLE: Closeness/Social Presence Logbook Study

DATE: 16th September 2010

Closeness/Social Presence – Briefing Script

In this study we are interested in how communication between people affects how close they feel to one another. We are interested in your feelings of closeness both whilst actually communicating and also at other times. During this study you will be partnered with someone you feel close to. Who this person is will already have been determined. We would like you to record your feelings in a **Daily Diary** and a **Contact Diary** (see below).

Your notes in the **Daily Diary** and the **Contact Diary** will be kept strictly confidential by anonymising the entries.

We are particularly interested in how different communication technologies (telephones, email, texts) have an impact on how close you feel to your partner. We are also interested in how the feeling of emotional connectedness from these communication technologies changes how close you feel to your partner.

During the study, you will be asked to fill in a **Daily Diary**. We would like you to do this as early in the day as possible, before any communication from your partner. Every day you will be asked to rank how close to your partner you feel. This is done by circling the diagram which best describes how you feel. It is about you overall feelings of closeness towards them.

[The experimenter will now show you the daily diary].

During the study, you will also be asked to fill in a **Contact Diary**. We would like you to complete an entry every time you have communication with your partner, as quickly after that communication as possible. It is about your feelings whilst communicating with them on that occasion.

[The experimenter will now show you the contact diary].

You are free at any time to withdraw from the study. If you do decide to withdraw, please inform the experimenter.

If you have any questions or problems with the study, don't hesitate to contact the experimenter.

Experimenter: Daniel Gooch, Department of Computer Science, University of Bath, Bath, BA2 7AY. D.J.Gooch@bath.ac.uk

Department of Computer Science

UNIVERSITY OF BATH

Contact Diary Instructions

This diary is intended as a record of all the communication you have had with your study partner.

Every time you communicate with your study partner please fill in a new record.

The first part of each record consists of some simple questions about the contact. There are then 9 items where you have to indicate which word best describes the contact (and by how much).

There is then an identical diagram to the ones in the **Daily Diary**. Circle the diagram which best represents how close you feel to your study partner. The circles labelled “self”, refer to you. The circles labelled “other” refer to your study partner.

Any questions?

Email D.J.Gooch@bath.ac.uk

Daily Diary Instructions

This diary is intended to be a daily record of how close you feel to your study partner.

At around the same time each day, preferably early in the morning, circle the diagram which best represents how close you feel to your study partner. The circles labelled “self”, refer to you. The circles labelled “other” refer to your study partner.

Any questions?

Email D.J.Gooch@bath.ac.uk

B.2 Statistical Validity

B.2.1 Linearity of the relationship between dependent and independent variables

Figure B.1 shows a plot of the observed versus predicted values of Social Presence. The symmetrical distribution around a diagonal line demonstrates that this linear relationship exists and that this assumption is met.

B.2.2 Independence of the errors (no serial correlation)

Figure B.2 shows an autocorrelation plot of residuals. There is no clear evidence that there are any violations of independence. This assumption is met.

B.2.3 Homoscedasticity (constant variance) of the errors

Figure B.3 shows a plot of residuals versus predicted values of Social Presence. There is no clear evidence that residuals are getting larger as a function of the predicted value. This assumption is met.

B.2.4 Normality of the error distribution

Figure B.4 shows a histogram of the residual with a normality curve. Figure B.5 shows a normality plot of the residuals. Although there is a slight bow to the line, the majority of points fall close to the diagonal indicating a normal plot. This assumption is met.

The main assumption for the repeated measures ordinal logistic regression test it that the effect of the independent variable is the same for different logit functions (also known as the proportional odds model). This assumption is dealt with by the Generalised Estimating Equations facility in SPSS 20 when calculating the Wald Chi-Square values.

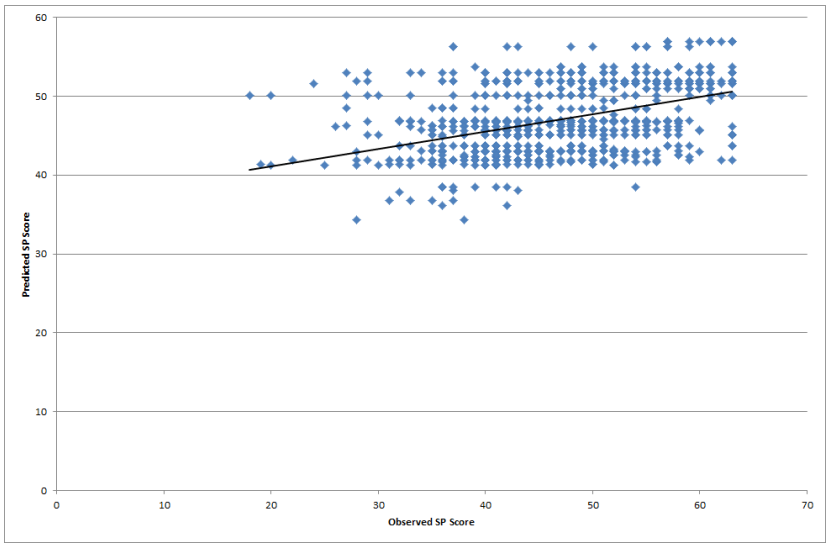

Figure B.1: Graph plotting observed SP values against predicted SP values

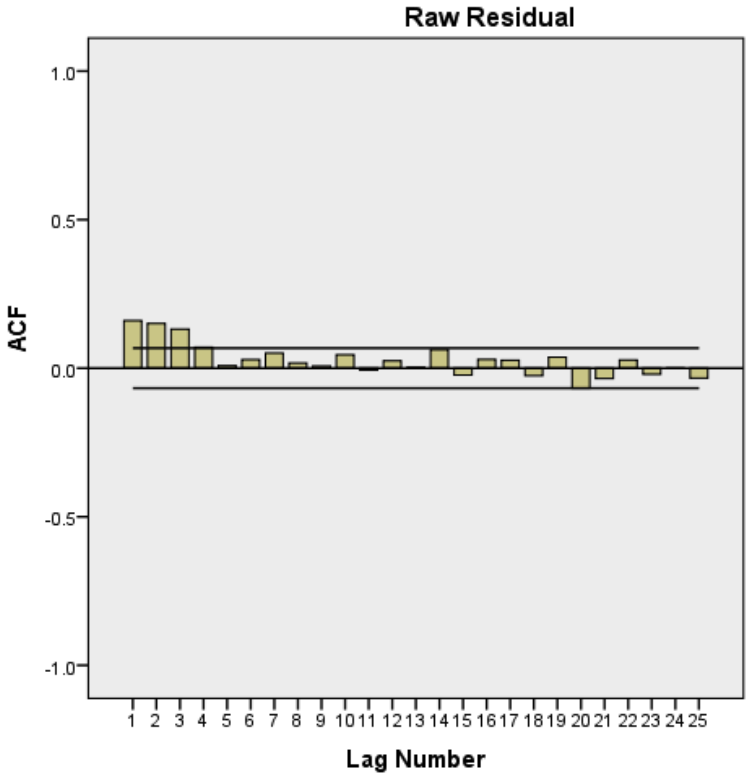

Figure B.2: Graph plotting the autocorrelation of the residuals

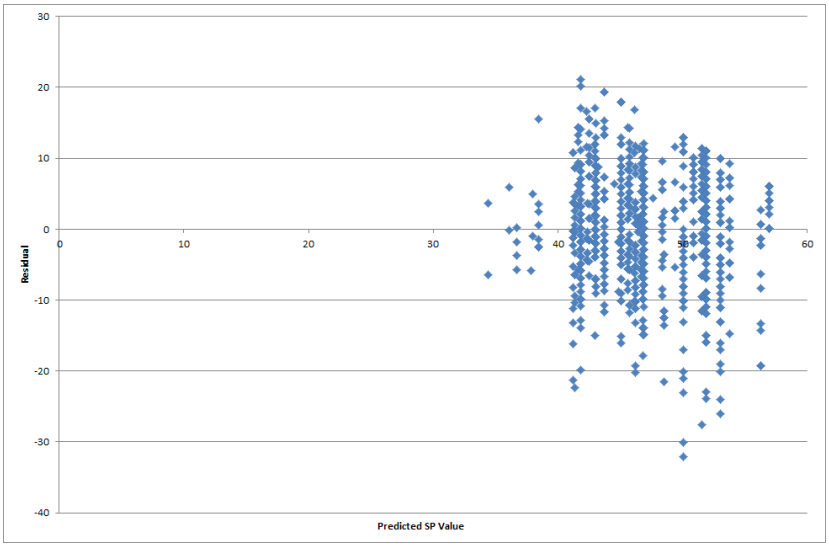

Figure B.3: Graph plotting residuals versus predicted SP values

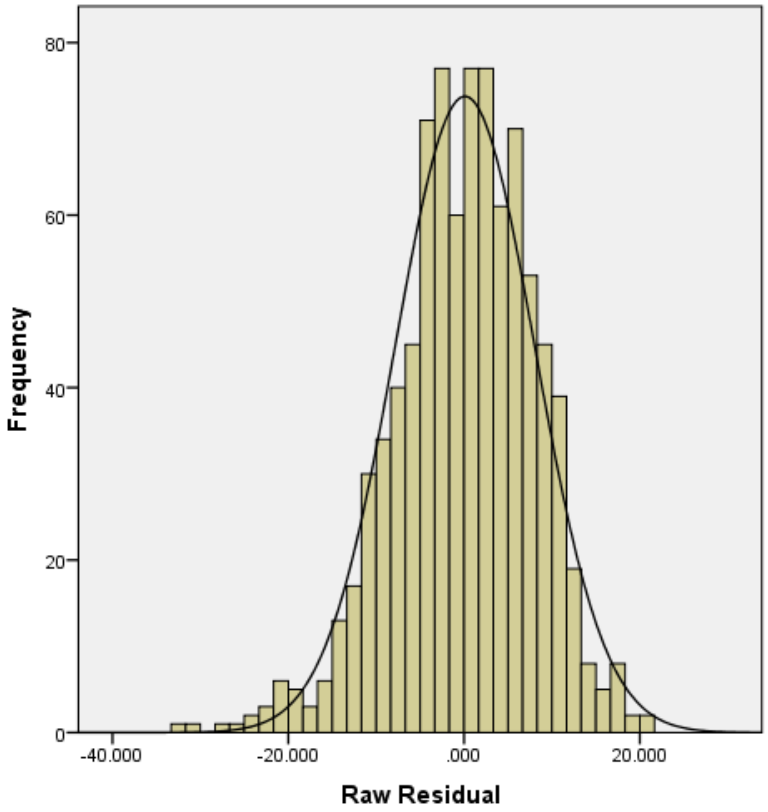

Figure B.4: Histogram showing a frequency plot of residuals

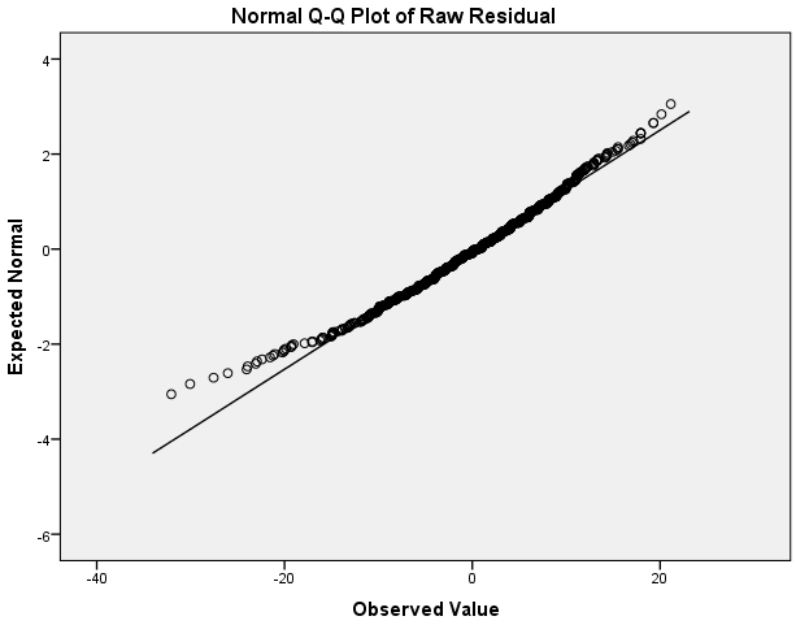

Figure B.5: Graph plotting the normality of the residuals

B.3 Predicting SP Scores

Model Parameters	**Corrected Quasi Likelihood under Independence Model Criterion**	**df**
Relationship	66737.322	3
Distance	68087.305	1
Communication Media	59620.716	10
Relationship x Distance	64959.670	7
Relationship Distance	65722.073	4
Relationship x Distance Communication Media	55699.923	17
Relationship Distance Communication Media	55938.645	14
Relationship x Distance x Communication Media	50494.833	50

Table B.1: Corrected Quasi Likelihood under Independence Model Criterion for various parameters

B.4 Predicting Closeness Scores

Model Parameters	**Convergence**
SP Levels	✔
SP Levels Relationship	✔
SP Levels x Relationship	✗
SP Levels Distance	✔
SP Levels x Distance	✔
SP Levels Relationship Distance	✗
SP Levels Relationship x Distance	✔
SP Levels x Relationship x Distance	✗
SP x Relationship SP x Distance	✗
Communication Media	✗
SP Levels Communication Media	✗
SP Levels Distance Communication Media	✗
SP Levels Relationship Communication Media	✗
SP Levels Relationship x Distance Communication Media	✗

Table B.2: Convergence of various models underpinning the regression model

The regression model indicates that both relationship x distance (wald chi-square(7) = 72.286, p < 0.001) and SP level (wald chi-square(41) = 2341.187, p < 0.001) are significant predictors of Daily Closeness ratings.

			95% Wald Confidence Interval		Hypothesis Test				95% Wald Confidence Interval Exp(B)	
Parameter	**B**	**Std. Error**	**Lower**	**Upper**	**Wald Chi-Square**	**df**	**sig**	**Exp(b)**	**Lower**	**Upper**
Friend x Distant	-1.31	0.47	-2.23	-0.39	7.78	1	0.005	0.271	0.108	0.678
Friend x Co-located	-0.71	0.45	-1.59	0.17	2.5	1	0.112	0.491	0.204	1.180
Sibling x Distant	-0.99	0.44	-1.85	-0.14	5.20	1	0.023	0.370	0.158	0.870
Sibling x Co-located	1.23	0.39	0.46	2.01	9.75	1	0.002	3.433	1.583	7.445
Parent x Distant	0.29	0.45	-0.59	1.18	0.42	1	0.515	1.341	0.555	3.241
Parent x Co-located	-1.19	0.48	-2.12	-0.26	6.25	1	0.012	0.304	0.120	0.773
Partner x Distant	-0.09	0.48	-1.02	0.84	0.04	1	0.852	0.915	0.360	2.323
Partner x Co-Located	Comparison category									
SP = 18	Hessian Matrix Singularity									
SP = 19	0.05	0.49	-0.92	1.02	0.01	1	0.920	1.051	0.399	2.678
SP = 20	-2.15	0.50	-3.14	-1.17	18.36	1	0.001	0.116	0.044	0.311
SP = 22	-3.91	0.75	-5.38	-2.44	27.11	1	0.001	0.020	0.005	0.088
SP = 24	-5.41	0.37	-6.13	-4.68	213.67	1	0.001	0.004	0.002	0.009
SP = 25	Hessian Matrix Singularity									
SP = 26	-0.61	0.39	-1.39	0.17	2.35	1	0.125	0.543	0.248	1.185
SP = 27	-0.37	0.88	-2.10	1.37	0.17	1	0.679	0.694	0.122	3.927
SP = 28	-1.87	1.01	-3.85	0.11	3.41	1	0.065	0.155	0.021	1.120
SP = 29	-2.01	0.41	-2.82	-1.19	23.40	1	0.001	0.134	0.060	0.303

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Table B.3 – continued from previous page

			95% Wald Confidence Interval		Hypothesis Test				95% Wald Confidence Interval Exp(B)	
Parameter	**B**	**Std. Error**	**Lower**	**Upper**	**Wald Chi-Square**	**df**	**sig**	**Exp(b)**	**Lower**	**Upper**
SP = 30	-2.02	0.75	-3.49	-0.56	7.34	1	0.007	0.132	0.031	0.571
SP = 31	-2.52	0.80	-4.09	-0.95	9.85	1	0.002	0.081	0.017	0.389
SP = 32	-0.74	0.49	-1.69	0.21	2.32	1	0.128	0.476	0.183	1.238
SP = 33	-2.00	0.53	-3.04	-0.97	14.41	1	0.001	0.134	0.048	0.379
SP = 34	-1.20	0.54	-2.26	-0.15	4.96	1	0.026	0.300	0.104	0.865
SP = 35	-1.49	0.51	-2.48	-0.50	8.69	1	0.003	0.225	0.084	0.607
SP = 36	-1.68	0.44	-2.55	-0.81	14.38	1	0.001	0.186	0.078	0.444
SP = 37	-1.50	0.58	-2.62	-0.37	6.76	1	0.009	0.224	0.073	0.692
SP = 38	-1.54	0.56	-2.64	-0.43	7.42	1	0.006	0.215	0.071	0.650
SP = 39	-1.58	0.44	-2.43	-0.73	13.17	1	0.001	0.206	0.088	0.484
SP = 40	-1.28	0.43	-2.11	-0.44	8.93	1	0.003	0.279	0.121	0.645
SP = 41	-1.86	0.47	-2.78	-0.94	15.80	1	0.001	0.156	0.062	0.390
SP = 42	-1.80	0.38	-2.55	-1.06	22.40	1	0.001	0.165	0.078	0.348
SP = 43	-1.05	0.53	-2.08	-0.02	3.96	1	0.047	0.352	0.126	0.984
SP = 44	-1.96	0.47	-2.88	-1.05	17.59	1	0.001	0.140	0.056	0.351
SP = 45	-1.71	0.39	-2.46	-0.95	19.57	1	0.001	0.182	0.085	0.387
SP = 46	-1.52	0.50	-2.49	-0.54	9.22	1	0.002	0.220	0.083	0.585
SP = 47	-1.26	0.53	-2.31	-0.22	5.59	1	0.018	0.282	0.099	0.806
SP = 48	-1.12	0.39	-1.88	-0.35	8.10	1	0.004	0.328	0.152	0.707

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Table B.3 – continued from previous page

			95% Wald Confidence Interval		Hypothesis Test				95% Wald Confidence Interval Exp(B)	
Parameter	**B**	**Std. Error**	**Lower**	**Upper**	**Wald Chi-Square**	**df**	**sig**	**Exp(b)**	**Lower**	**Upper**
SP = 49	-1.03	0.42	-1.86	-0.20	5.91	1	0.015	0.357	0.156	0.819
SP = 50	-0.61	0.51	-1.61	0.38	1.46	1	0.227	0.542	0.200	1.465
SP = 51	-1.52	0.37	-2.24	-0.80	16.94	1	0.001	0.219	0.106	0.451
SP = 52	-0.99	0.38	-1.74	-0.26	6.97	1	0.008	0.369	0.176	0.774
SP = 53	-0.82	0.47	-1.74	0.11	2.99	1	0.083	0.443	0.176	1.113
SP = 54	-0.70	0.41	-1.52	0.11	2.87	1	0.090	0.495	0.220	1.116
SP = 55	-0.36	0.37	-1.08	0.35	0.96	1	0.327	0.699	0.341	1.432
SP = 56	-0.40	0.44	-1.27	0.46	0.84	1	0.360	0.669	0.282	1.584
SP = 57	-0.70	0.56	-1.80	0.39	1.57	1	0.210	0.495	0.165	1.487
SP = 58	-0.94	0.51	-1.94	0.06	3.43	1	0.064	0.390	0.144	1.057
SP = 59	-0.34	0.39	-1.10	0.41	0.79	1	0.375	0.710	0.333	1.513
SP = 60	0.06	0.58	-1.09	1.20	0.01	1	0.925	1.056	0.338	3.304
SP = 61	0.26	0.54	-0.81	1.32	0.23	1	0.635	1.294	0.446	3.750
SP = 62	-1.08	0.39	-1.86	-0.30	7.38	1	0.007	0.339	0.156	0.740
SP = 63	Comparison category									

Table B.3: Parameter Estimates from the repeated measures ordinal logistic regression

B.5 Qualitative Analysis

First Set	Second Set
Personal	Personal Connection
Significant Experience	⇑
Emotional Stress	⇑
Effort	Time and Effort
Communication Management	Manageability
Comprehension	⇑
Purpose	⇑
Comprehension	⇑
Response Time	Responsiveness
Convenience	⇑
Fleetingness	Fleetingness
Physicality	Physicality

Table B.4: Coding of the questionnaire responses

Appendix C

Exploratory Interviews and Refined Design Space Supporting Material

C.1 Interview Ethics

Consent Form

Study Overview

This is a study about holding hands. We are investigating ways of mimicking intimate behaviours in communication systems for people in long distance relationships. As such, we've developed three prototype devices for couples in long distance relationships. The study will work as follows. First we will ask you to read a scenario. Having read it, we will then ask you some questions. We will then ask you to use a prototype device and then ask some more questions. After doing that for all 3 prototypes, we will ask some final questions. Finally we will give you the £10 for participation.

Important Information

We will be audio recording the study. The audio will be transcribed in an anonymous form. If you have concerns about being recorded, please let the experimenter know.

There are no hidden procedures and no deception is involved in this study. All data collected during this study will be recorded such that your individual results are anonymous and cannot be traced back to you. Your results will not be passed to any third party and are not being collected for commercial reasons. The results may be published in an anonymous form.

Participation in this study does not involve physical or mental risks outside of those encountered in everyday life. You have the right to withdraw from the study at any time. If you do decide to withdraw, please inform the experimenter.

By signing this form you acknowledge that you have read the information given and understand what you are being asked to do and freely agree to participate in this study.

Name: _____ Age: _____

Gender: _____ Occupation: _____

Where do you live?

Where does your partner live?

How long have you known your study partner?

Signed: _____ Date: _____

UNIVERSITY OF BATH

Department of Computer Science

13-POINT ETHICS CHECK LIST: Closeness/Social Presence Logbook Study

This document describes the 13 issues that need to be considered carefully before students or staff involve other people ("participants") for the collection of information as part of their project or research.

1. *Have you prepared a briefing script for volunteers?*

A briefing script has been prepared. It will be given to volunteers by both text and voice. A copy will be included in all of the logbooks. The briefing script will include details of what they will be required to do, the kind of data I will be collecting and how it will be used.

2. *Will the participants be using any non-standard hardware?*

Yes. It has been tested extensively to ensure that it runs little risk of harming the participants. Similarly, safety features have been added to ensure that if the device goes wrong it can be removed quickly, minimising harm to the user.

3. *Is there any intentional deception of the participants?*

No

4. *How will participants voluntarily give consent?*

A consent form will be signed by all participants which will explain that the data may be published in an anonymous form.

5. *Will the participants be exposed to any risks greater than those encountered in their normal work life?*

No

6. *Are you offering any incentive to the participants?*

All participants will be given a reward of £10.

7. *Are any of your participants under the age of 16?*

No

8. *Do any of your participants have an impairment that will limit their understanding or communication?*

No

9. Are you in a position of authority or influence over any of your participants?

I will be tutoring some of the participants but this will not be used to pressurise participants to take part.

10. Will the participants be informed that they could withdraw at any time?

This is included in the briefing script and consent form.

11. Will the participants be informed of your contact details?

Contact details are included in the briefing script and consent form.

12. Will participants be de-briefed?

A debrief will be undertaken at the end of the interviews.

13. Will the data collected from the participants be stored in an anonymous form?

Yes

NAME: Daniel Gooch

SUPERVISOR (*IF APPLICABLE):* _____

SECOND READER (IF APPLICABLE): _____

PROJECT TITLE: Closeness/Social Presence Interview Study

DATE: 3rd December 2011

Instructions

This study is all about hand holding and long distance relationships. We have developed three different prototype communication systems, based around hand holding, to help support long distance relationships. The aim of this study is to investigate what you think about each of the prototypes.

The process is as follows:

1) We will show you a scenario describing a design concept
2) We will then ask you some questions about the concept
3) We will show you a prototype which realises the design concept
4) We will ask you some more questions

We will do this for all 3 prototypes before asking some final questions.

C.2 Initial Interviews Supporting Material

P

YourGlove

Michael and Samantha are long distance partners. Having managed to meet up, their weekend together is coming to an end. Before parting, Samantha passes a gift wrapped box to Michael. “What’s this?” he asks her. “Open it and see!”. Unwrapping it, Michael discovers one of Samantha’s favourite gloves and one of her bracelets pulled over a dummy hand. “What on earth is this?” Michael exclaims. “It’s a YourGlove” Samantha explains “I’ve got one too. You decorate the hand with my favourite glove and then when we’re chatting we can use it to hold hands. When I hold mine, yours will close and when you hold yours, mine will close”. “I see” said Michael “That’s so sweet – it’ll be like holding hands when we’re apart”. “Exactly” smiled Samantha.

The couple part and we re-join them one dark evening several weeks later. We can see them chatting away on Skype, the personalised Yourgloves taking pride of place on their desks. Before we leave, we see Michael slip his hand into his YourGlove and Samantha smile as she feels Mike holding her hand.

D

YourGlove

Michael and Samantha are long distance partners. Having managed to meet up, their weekend together is coming to an end. Before parting, Samantha passes a gift wrapped box to Michael. “What’s this?” he asks her. “Open it and see!”. Unwrapping it, Michael discovers what looks to be a cool gadget nestled in tissue paper, a glove covered dummy hand. “What on earth is this?” Michael exclaims. “It’s a YourGlove” Samantha explains “I’ve got one too. It’s a new thing I found in town. When we’re chatting you can use it to hold hands. When I hold mine, yours will close and when you hold yours, mine will close”. “I see” said Michael excitedly “That’s so cool – it’ll be like holding hands when we’re apart”. “Exactly” smiled Samantha.

The couple part and we re-join them one dark evening several weeks later. We can see them chatting away on Skype, the slick Yourgloves taking pride of place on their desks. Before we leave, we see Michael slip his hand into his YourGlove and Samantha smile as she feels Mike holding her hand.

P

HotMits

Jane and Ben are long distance lovers. We join them at the start of a rare weekend together. Jane has proposed that they make imprints of their hands. “Why would we do that?” Ben asks quizzically. “Well I got the idea online” Jane replies “I ordered a kit – what you do is take an imprint of each other’s hand and then add some electronic stuff. Then when we’re chatting online, if you put your hand into my imprint, the imprint that I keep warms up. Likewise, when I put my hand in the imprint I keep, your imprint warms up.”. “ I see” says Ben “so it’s kind of like holding hands together while we’re apart”. “Exactly” smiles Jane “and the imprints are paintable so that we can decorate them how we like”. Ben giggles “Well mine’s going to have to be yellow, doesn’t it” he joked, referring to Jane’s favourite colour. We leave as the conversation moves onto other things. The following day, the couple are clearly enjoying themselves as they go through the kit instructions together to make the hand imprints.

We re-join the couple one dark evening several weeks later. We can see them chatting away on Skype, the clearly decorated hand imprints taking pride of place on their desks. Before we leave, we see Michael slip his hand into his imprint and Samantha smile as she feels Mike holding her hand.

D

HotMits

Jane and Ben are long distance lovers. We join them at the start of a rare weekend together. Jane starts explaining to Ben about something she recently bought online and that she'd like them to try. "These devices are imprints of a hand along with some electronic stuff. When we're chatting online, if you put your hand into your imprint, the imprint that I keep warms up. Likewise, when I put my hand in the imprint I keep, your imprint warms up.". " I see" says Ben "so it's kind of like holding hands together while we're apart". "Exactly" smiles Jane". "Well, sounds cool to me – it'll be so neat to feel the heat!" Ben says. "I'm glad you said that" sighs Jane, clearly relieved "as I've got two of them for us to try out" she says, bringing out two funky looking boxes. We leave as the conversation moves onto other things.

We re-join the couple one dark evening several weeks later. We can see them chatting away on Skype, the slick hand imprints taking pride of place on their desks. Before we leave, we see Michael slip his hand into his imprint and Samantha smile as she feels Mike holding her hand.

P

HotHands

Peter and Louise are long distance partners. We join them at the start of a rare weekend together. “Why don’t we make models of our hands” Peter blurts out. “Ummmm, OK, but why?” Louise asks quizzically. “Well I got the idea online - I came across a site called HotHands” Peter replies “I ordered a kit – what you do is make a model of each other’s hand and then add some electronic stuff. Then when we’re chatting online, if you put your hand on top of my model hand, the model hand that I keep warms up. Likewise, when I put my hand onto the hand I keep, your model warms up.”. “ I see” exclaims Louise “so it’s kind of like holding hands together while we’re apart”. “Exactly” smiles Peter “and the hands are paintable so that we can decorate then how we like”. Louise giggles “Well mine’s going to have to be blue, doesn’t it” she joked, referring to Peter’s favourite colour. We leave as the conversation moves onto other things. The following day, the couple are clearly enjoying themselves as they go through the kit instructions together to make the model hands.

We re-join the couple one dark evening several weeks later. We can see them chatting away on Skype, the clearly decorated model hands taking pride of place on their desks. Before we leave, we see Michael slip his hand onto his HotHand and Samantha smile as she feels Mike holding her hand.

D

HotHands

Peter and Louise are long distance partners. We join them at the start of a rare weekend together. Peter blurts out “I found these really cool things online” and puts a box on the table. He opens the box and nestled in some tissue paper we can see two models of hands. “These are models of hands along with some electronic stuff. Then when we’re chatting online, if you put your hand onto the model, the hand that I keep warms up. Likewise, when I put my hand on the model I keep, your hand warms up.”. “ I see” exclaims Ben “so it’s kind of like holding hands together while we’re apart”. “Exactly” smiles Jane“. “Well, sounds cool to me” Ben says. “I’m glad you said that” sighs Jane, clearly relieved “as I’ve got two of them for us to try out” she says, bringing out two funky looking boxes. We leave as the conversation moves onto other things.

We re-join the couple one dark evening several weeks later. We can see them chatting away on Skype, the slick model hands taking pride of place on their desks. Before we leave, we see Michael slip his hand onto his HotHand and Samantha smile as she feels Mike holding her hand.

C.3 Secondary Interviews Supporting Material

P

SleepyWhispers

Michael and Samantha are long distance partners. Having managed to meet up, their weekend together is coming to an end. Before parting, Samantha passes a gift wrapped box to Michael. “What’s this?” he asks her. “Open it and see!”. Unwrapping it, Michael discovers a photo frame containing a photo of Samantha and a new pillow. “What on earth is this?” Michael exclaims. “It’s a SleepyWhisper” Samantha explains “I’ve got one too. I can whisper messages to you through the day and then when it’s time for bed, you use the photo frame to listen to them through your pillow. I’ve got a set too so you can whisper to me as well. How sweet is that?” “I see” said Michael “That’s so sweet – I miss the sound of your voice before I go to sleep”. “Me too” smiled Samantha.

The couple part and we re-join Michael one dark evening several weeks later. Having got ready for bed, we can see him reading in bed. Tiring, he reaches for the photo frame (including Samantha’s photo) which we can see takes pride of place on his bedside table. Before we leave, we see Michael smile as he can hear Samantha’s voice come through his pillow whispering sweet nothings.

D

SleepyWhispers

Michael and Samantha are long distance partners. Having managed to meet up, their weekend together is coming to an end. Before parting, Samantha passes a gift wrapped box to Michael. “What’s this?” he asks her. “Open it and see!”. Unwrapping it, Michael discovers a photo frame containing a photo of a landscape scene and a new pillow. “What on earth is this?” Michael exclaims. “It’s a SleepyWhisper” Samantha explains “I’ve got one too. I can record messages for you through the day and then when it’s time for bed, you use the photo frame to listen to them through your pillow. I’ve got a set too so you can send me messages as well. How sweet is that?” “I see” said Michael “That’s so sweet – it’s like catching up with each other just before we go to sleep”. “Exactly” smiled Samantha.

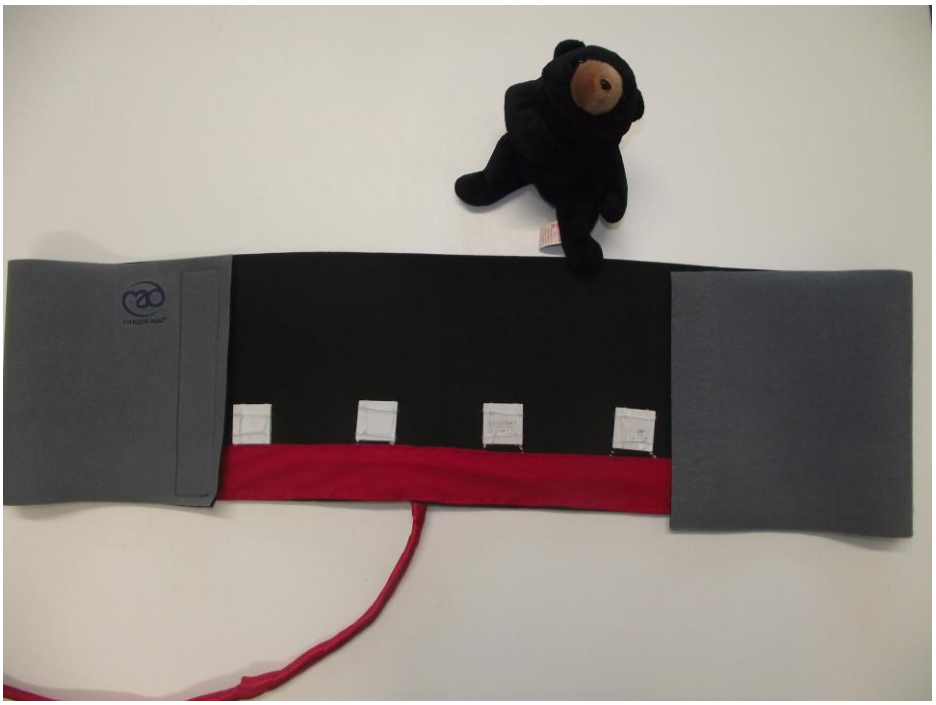
The couple part and we re-join Michael one dark evening several weeks later. Having got ready for bed, we can see him reading in bed. Tiring, he reaches for the photo frame which we can see takes pride of place on his bedside table. Before we leave, we see Michael smile as he can hear Samantha’s messages come through his pillow.

P

HotHugs

Jane and Ben are long distance lovers. We join them at the start of a rare weekend together. Jane reveals a gift wrapped box for Ben. “What’s this?” he asks a little puzzled. “Take a peek” replies Jane. Opening the box Ben finds what seems to be a slimming belt. “Why have you got me this” Ben asks, slightly shocked. “Relax” replies Jane “it’s not what it looks like. It’s a hug belt. When we’re chatting over Skype, you put this on and I can send you a hug”. “A hug?” asks Ben. “Sure, a hug. Well the belt warms up but it kind of feels like a hug. I’ve decorated the belt so that it reminds you of me – I’ve painted it and sewn things onto it. You send me a hug by squeezing this cuddly toy which I picked because I thought it would remind you of me…“. “Well it sounds like a nice idea” smiles Ben “guess we’ve just got to give it a go”. We leave as the conversation moves onto other things.

We re-join the couple one dark evening several weeks later. We can see them chatting away on Skype, the pair clearly wearing the customised hug belts. Before we leave, we see Ben reach for his toy and Jane smile as she feels Ben hugging her.

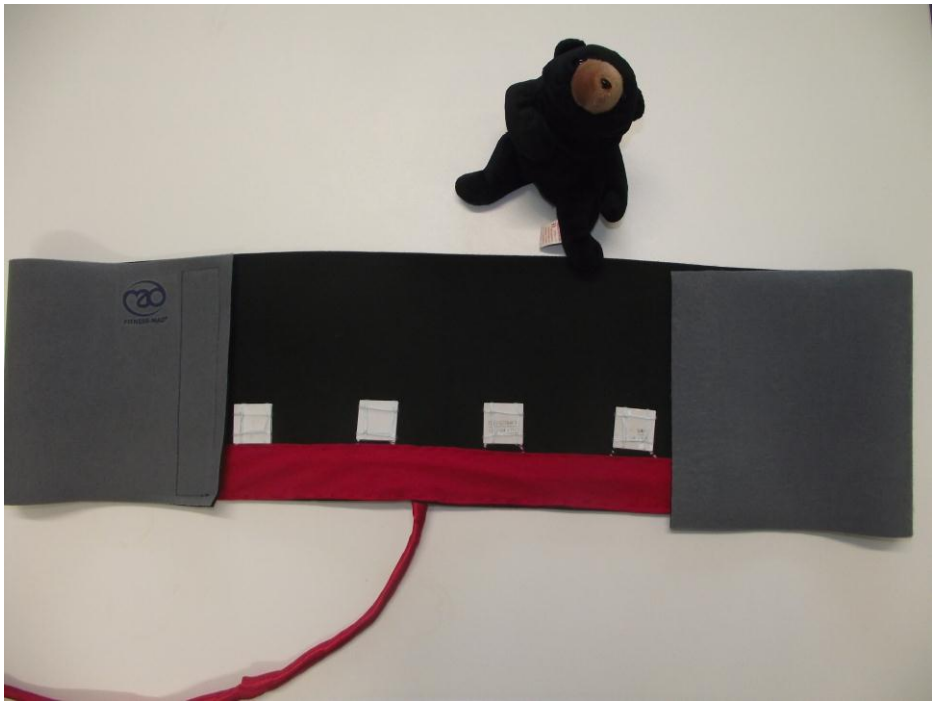


D

HotHugs

Jane and Ben are long distance lovers. We join them at the start of a rare weekend together. Jane reveals a gift wrapped box for Ben. “What’s this?” he asks a little puzzled. “Take a peek” replies Jane. Opening the box Ben finds what seems to be a slimming belt. “Why have you got me this” Ben asks, slightly shocked. “Relax” replies Jane “it’s not what it looks like. It’s a hug belt. When we’re chatting over Skype, you put this on and I can send you a hug”. “A hug?” asks Ben. “Sure, a hug. Well the belt warms up but it kind of feels like a hug. You send me a hug by squeezing this cuddly toy…“. “Well it sounds like a nice idea” smiles Ben “guess we’ve just got to give it a go”. We leave as the conversation moves onto other things.

We re-join the couple one dark evening several weeks later. We can see them chatting away on Skype, the pair clearly wearing the hug belts. Before we leave, we see Ben reach for his toy and Jane smile as she feels Ben hugging her.



P

Magic Sock Drawer

Peter and Louise are long distance partners. We join them at the start of a rare weekend together. Peter pulls out a large gift-wrapped box and passes it to Louise. “What’s this?” Louise asks quizzically. “Open it and take a peek” Pete replies smiling. Louise opens the box finding a tablet PC and a small credit-card sized printer. “Oh wow, awesome” says Louise “what is it?” “It’s called a Magic Sock Drawer” says Pete “I’ve already set mine up in my house. What it does is it allows you to draw me little pictures and notes using the digital pen on the tablet and then send them to me. The notes then print out automatically on my printer which I’ve hidden in my guitar amp as somewhere that’s personal to me – that way I find them at random times like the notes you leave around my house when you come to visit”. “I see” smiles Louise “ I like it. I think I’ll put mine in my sock drawer…”. We leave as the conversation moves onto other things.

We re-join Peter one dark evening several weeks later. We can see him playing on his guitar when he remembers about the notes. Before we leave, we see Pete peek into the amp where he smiles as he can see a couple of notes that Louise has sent him.

D

Magic Sock Drawer

Peter and Louise are long distance partners. We join them at the start of a rare weekend together. Peter pulls out a large gift-wrapped box and passes it to Louise. “What’s this?” Louise asks quizzically. “Open it and take a peek” Pete replies smiling. Louise opens the box finding a tablet PC and a small credit-card sized printer. “Oh wow, awesome” says Louise “what is it?” “It’s called a Magic Sock Drawer” says Pete “I’ve already set mine up in my house. What it does is allows you to type out little notes on the tablet and then send them to me. The notes then print out automatically on my printer which I’ve put on my desk – that way I find them at random times a bit like the notes you leave around my house when you come to visit”. “I see” smiles Louise “ I like it. I think I’ll put mine on my desk as well…”. We leave as the conversation moves onto other things.

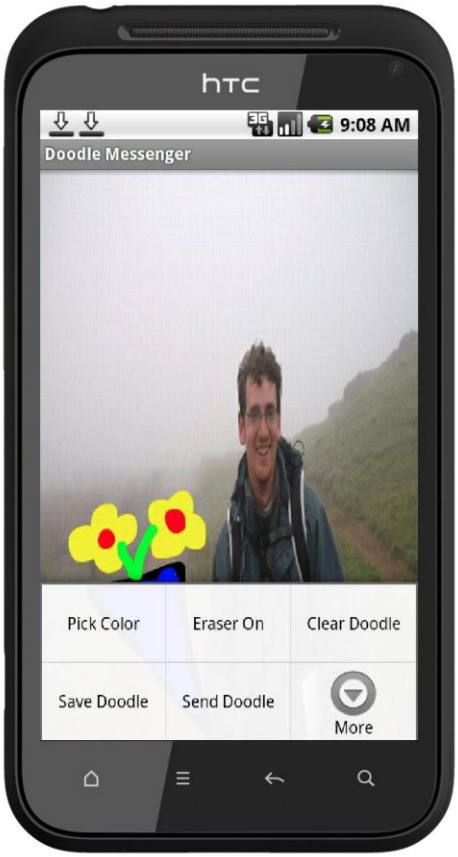
We re-join Peter one dark evening several weeks later. We can see him wander into his office when he remembers about the notes. Before we leave, we see Pete peek at the desk where he smiles as he can see a couple of notes that Louise has sent him.

P

DoodleMessenger

Peter and Louise are long distance partners. We join them at the start of a rare weekend together. “I found this awesome app the other day” Peter mentions. “Oh, yeah, what does it do?” asks Louise quizzically. “Well it’s called doodleMessenger. Here, take a look. What it does is it allows me to draw little doodles on my phone and then send them to other people. You can also doodle on top of photos and send those as well. You can either upload them onto facebook or flickr or send them to people as emails or text messages. I thought we could use it to swap notes while we’re apart…”. “That sounds like a really sweet idea” replied Louise “I’ll install it now”. We leave as we can see the couple starting to play with the app.

We re-join Peter one dark evening several weeks later. He’s on the bus on his way home after work. Pulling out his phone we can see him smiling as we see him doodle a note which he knows Louise will appreciate. We move on to see Louise giggle as she receives Pete’s note and start drawing her response.

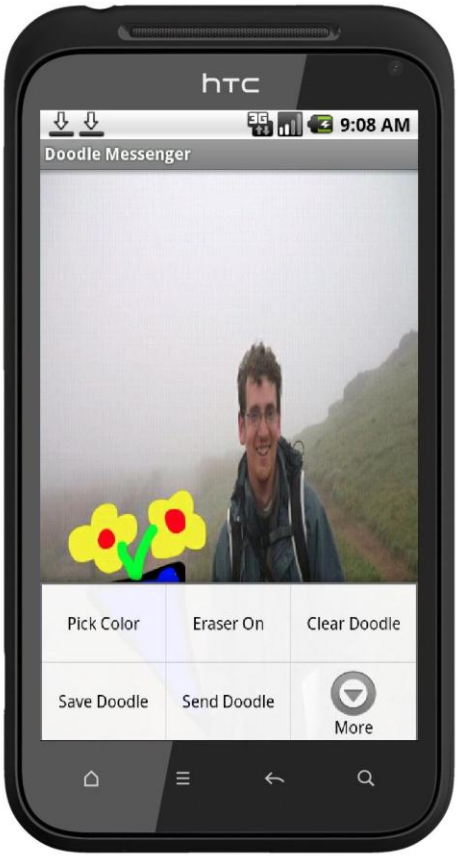


D

DoodleMessenger

Peter and Louise are long distance partners. We join them at the start of a rare weekend together. Peter says “I found this awesome app the other day”. “Oh, what does it do?” asks Louise quizzically. “Well it’s called doodleMessenger. Here, take a look. What it does is allow me to do is create little notes on my phone and then send them to other people – either upload them onto facebook or flickr or send them to people as emails or text messages. I thought we could use it to swap notes while we’re apart…”. “That sounds like a really sweet idea” replied Louise “I’ll install it now”. We leave as we can see the couple playing with the app.

We re-join Peter one dark evening several weeks later. He’s on the bus on his way home after work. Pulling out his phone we can see him smiling as we see him create a note which he knows Louise will appreciate. We move on to see Louise giggle as she receives Pete’s note and start creating her response.



C.4 The Prototype Devices and their respective Design facets

Design Facet	**sleepyWhispers**	**hotMitts**	**hotHands**	**yourGlove**	**doodleMessenger**	**hotHugs**	**MSD**
Personalisation	Through the use of voice and the selection of photos	Through casting the hand and subsequently decorating the cast	Through casting the hand and subsequently decorating the cast	Through selecting custom clothing and jewellery	Through drawing the notes	Through decorating the belt and the selection of soft toy	Through drawing the notes
Effort	In the caring creation of messages	Only in casting the device	Only in casting the device	No	In the caring design of meaningful notes	No	In the caring design of meaningful notes
Sensory Medium	Sound	Touch (heat)	Touch (heat)	Touch (movement)	Sight	Touch (heat)	Sight and Touch
Metaphor	Pillow talk	Hand holding	Hand holding	Hand holding	Sharing love notes	Hugging	Sharing love notes
Fleeting versus Realised	Both fleeting and realised	Fleeting	Fleeting	Fleeting	Realised	Fleeting	Realised
Serendipity versus planned	Planned	Planned	Planned	Planned	Serendipitous	Probably planned	Serendipitous
Synchronous?	Asynchronous	Synchronous	Synchronous	Synchronous	Asynchronous	Synchronous	Asynchronous
Reciprocal?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Availability	Fixed location	Fixed location	Fixed location	Fixed location	Mobile	Fixed location	Fixed location
Openness	1-to-1	1-to-1	1-to-1	1-to-1	1-to-many	1-to-1	1-to-1

Table C.1: Prototype device design space facets

Appendix D

Design Space Verification Supporting Material

Device	**Fleeting/ Realised**	**Serendipity/ Planned**	**Synchronous Media**	**Reciprocal**	**Available**	**Openness**
Feather, Scent and Shaker ([Strong and Gaver, 1996, Gaver, 2002])	Fleeting	Serendipitous	n/a	One Way only	Sending always, receiving only at home	One-to-one
Earmuffs ([Gaver, 2002])	Fleeting	Serendipitous	n/a	One way	Always	One-to-one
Kiss ([Gaver, 2002])	Fleeting	Serendipitous	n/a	One way	Always	One-to-one
inTouch ([Brave and Dahley, 1997])	Fleeting	Planned	Synchronous	Highly	At fixed location	One-to-one
Virtual Intimate Object ([Kaye et al., 2005, Kaye, 2006, 2005a,b])	Fleeting	Serendipitous	Asynchronous	Yes	On fixed PC	One-to-one
inStink ([Kaye, 2000, 2004])	Fleeting	Serendipitous	Yes	No	Fixed location	One-to-one
inTouch ([Hindus et al., 2001])	Fleeting	Serendipitous	Yes	No	Mobile	One-to-one
Love Egg ([Kaye and Goulding, 2004])	Insufficient information	Planned	No	Yes	Fixed location	One-to-one

Continued on next page

Table D.1 – continued from previous page

Device	**Fleeting/ Realised**	**Serendipity/ Planned**	**Synchronous Media**	**Reciprocal**	**Available**	**Openness**
Hand-holding ([Kaye and Goulding, 2004])	Fleeting	Insufficient information	Yes	No	Insufficient information	One-to-one
The Bed ([Dodge, 1997])	Fleeting	Planned	Yes	Yes	Fixed location	One-to-one
The Sensing Beds ([Goodman and Misilim, 2003])	Fleeting	Planned	Yes	No	Fixed location	One-to-one
Ruug [Thompson et al., 2005])	Fleeting	Serendipitous or planned depending on use	No	No	Fixed location	One-to-one
ComSlipper ([Chen et al., 2006])	Fleeting	Serendipitous	Yes	Yes	Mobile	One-to-one
Habitat ([Patel and Agamanolis, 2003])	Fleeting	Serendipitous	Yes	Yes	Fixed location	One-to-one
SyncDecor ([Tsujita et al., 2008])	Fleeting	Serendipitous	Yes	Yes	Fixed Location	One-to-one

Continued on next page

Table D.1 – continued from previous page

Device	Fleeting/ Realised	Serendipity/ Planned	Synchronous Media	Reciprocal	Available	Openness
Lover's Cups ([Chung et al., 2006])	Fleeting	Planned	Yes	Yes	Mobile	One-to-one
TSUNAGARI ([Itoh et al., 2002])	Fleeting	Serendipitous	Yes	Yes	Fixed location	One-to-one
Digital Family Portraits ([Mynatt et al., 2001, Rowan and Mynatt, 2005])	Fleeting	Planned	Yes	No	Fixed location	One-to-one
The Hug ([DiSalvo et al., 2003, Gemperle et al., 2003])	Fleeting	Serendipitous	No	Yes	Mobile	Insufficient information
Hug over a distance ([Mueller et al., 2005])	Fleeting	Serendipitous	Yes	No	Mobile	One way one-to-one
Gustbowl ([van der Hoog et al., 2004])	Fleeting	Planned	Yes	Insufficient information	Fixed location	One-to-one

Continued on next page

Table D.1 – continued from previous page

Device	**Fleeting/ Realised**	**Serendipity/ Planned**	**Synchronous Media**	**Reciprocal**	**Available**	**Openness**
Social Radio ([Röcker and Etter, 2007])	Fleeting	Serendipitous	Yes	Yes	Mobile	Many-to-many
Magic Box ([Vetere et al., 2006, 2009, Davis et al., 2008])	Realised	Planned	No	Yes	Fixed location	One-to-one
HomeNote ([Sellen et al., 2006b])	Realised in so far as the note is recorded	Serendipitous	No	No	Fixed location	Many-to-one
Wayve ([Lindley et al., 2010])	Realised in so far as notes are recorded	Serendipitous	No	Yes	Fixed location	Many-to-many
ASTRA ([Markopoulos et al., 2004, Romero et al., 2007])	Realised in so far as notes are recorded	Serendipitous collection, planned review	No	No	Mobile creation, fixed review	Many-to-one
Kissenger ([Samani et al., 2012])	Fleeting	Planned	Yes	Yes	Insufficient information	One-to-one

Continued on next page

Table D.1 – continued from previous page

Device	**Fleeting/ Realised**	**Serendipity/ Planned**	**Synchronous Media**	**Reciprocal**	**Available**	**Openness**
United-Pulse ([Werner et al., 2008])	Fleeting	Serendipitous	Yes	Yes	Intended to be mobile	One-to-one
Gumball ([Truong et al., 2004])	Realised	Serendipity	Yes	no	Fixed location	One-to-one
Lover's Box ([Thieme et al., 2011])	Fleeting	Planned	No	Yes	Fixed location	One-to-one
TapTap ([Bonanni et al., 2006])	Fleeting	Serendipitous	Yes	Yes	Mobile	One-to-one
Peek-a-drawer ([Siio et al., 2002])	Fleeting	Serendipity	Yes	Yes	Fixed location	One-to-one

Table D.1: An analysis of the features of various devices designed to support intimate relationships in terms of our proposed design space

Appendix E

Case Study Supporting Material

E.1 Case Study Ethics

UNIVERSITY OF BATH

Department of Computer Science

13-POINT ETHICS CHECK LIST: Closeness/Social Presence Logbook Study

This document describes the 13 issues that need to be considered carefully before students or staff involve other people ("participants") for the collection of information as part of their project or research.

1. *Have you prepared a briefing script for volunteers?*

A briefing script has been prepared. It will be given to volunteers by both text and voice. A copy will be included in all of the logbooks. The briefing script will include details of what they will be required to do, the kind of data I will be collecting and how it will be used.

2. *Will the participants be using any non-standard hardware?*

Yes. It has been tested extensively to ensure that it runs little risk of harming the participants. Similarly, safety features have been added to ensure that if the device goes wrong it can be removed quickly, minimising harm to the user.

3. *Is there any intentional deception of the participants?*

No

4. *How will participants voluntarily give consent?*

A consent form will be signed by all participants which will explain that the data may be published in an anonymous form.

5. *Will the participants be exposed to any risks greater than those encountered in their normal work life?*

No

6. *Are you offering any incentive to the participants?*

All participants will be given a reward of £50.

7. *Are any of your participants under the age of 16?*

No

8. *Do any of your participants have an impairment that will limit their understanding or communication?*

No

9. Are you in a position of authority or influence over any of your participants?

I will be tutoring some of the participants but this will not be used to pressurise participants to take part.

10. Will the participants be informed that they could withdraw at any time?

This is included in the briefing script and consent form.

11. Will the participants be informed of your contact details?

Contact details are included in the briefing script and consent form.

12. Will participants be de-briefed?

A debrief will be undertaken at the end of the interviews.

13. Will the data collected from the participants be stored in an anonymous form?

Yes

NAME: Daniel Gooch

SUPERVISOR (*IF APPLICABLE):* _____

SECOND READER (IF APPLICABLE): _____

PROJECT TITLE: Closeness/Social Presence Interview Study

DATE: 12th March 2012

DoodleMessenger Consent Form

Study Overview

This is a study of the doodleMessenger app. For 4 weeks you will be using the doodleMessenger app to exchange hand drawn notes with your partner. Full details are given in your briefing script. In addition, for two weeks before the study, during the study and for two weeks after the study, we will be collecting diary information about your relationship and your communication habits.

Important Information

There are no hidden procedures and no deception is involved in this study. The data recorded include a daily diary, a contact diary and all of the messages sent through the doodleMessenger app. All data collected during this study will be recorded such that your individual results are anonymous and cannot be traced back to you. Your results will not be passed to any third party and are not being collected for commercial reasons. Your partner will never see your data. The results may be published in an anonymous form.

Participation in this study does not involve physical or mental risks outside of those encountered in everyday life. You have the right to withdraw from the study at any time. If you do decide to withdraw, please inform the experimenter.

By signing this form you acknowledge that you have read the information given above and understand what you are being asked to do and freely agree to participate in this study.

Name: _____ Age: _____

Gender: _____ Occupation: _____

How do you know your partner?

How long have you known your partner?

Signed: _____ Date: _____

Experimenter: Daniel Gooch, Department of Computer Science, University of Bath, Bath, BA2 7AY. D.J.Gooch@bath.ac.uk.

Department of Computer Science

UNIVERSITY OF BATH

Daily Diary Instructions

This diary is intended to be a daily record of how close you feel to your partner.

At around the same time each day, preferably early in the morning, circle the diagram which best represents how close you feel to your partner. The circles labelled “self”, refer to you. The circles labelled “other” refer to your partner.

This diary also contains a free-form component where we would like you to reflect upon your relationship and how your communication habits impact on how you feel about your partner. We include some prompts of some things we would like you to think about when filling in this diary.

Any questions?

Email D.J.Gooch@bath.ac.uk

Department of Computer Science

UNIVERSITY OF BATH

Contact Diary Instructions

This diary is intended to be a record of all the communication you have with your partner.

Every time you communicate with your partner please fill in a new record.

The first part of each record consists of some simple questions about the contact. There are then 9 items where you have to indicate by circling which word best describes the contact.

There is then an identical diagram to the ones in the **Daily Diary**. Circle the diagram which best represents how close you feel to your study partner. The circles labelled “self”, refer to you. The circles labelled “other” refer to your partner.

Any questions?

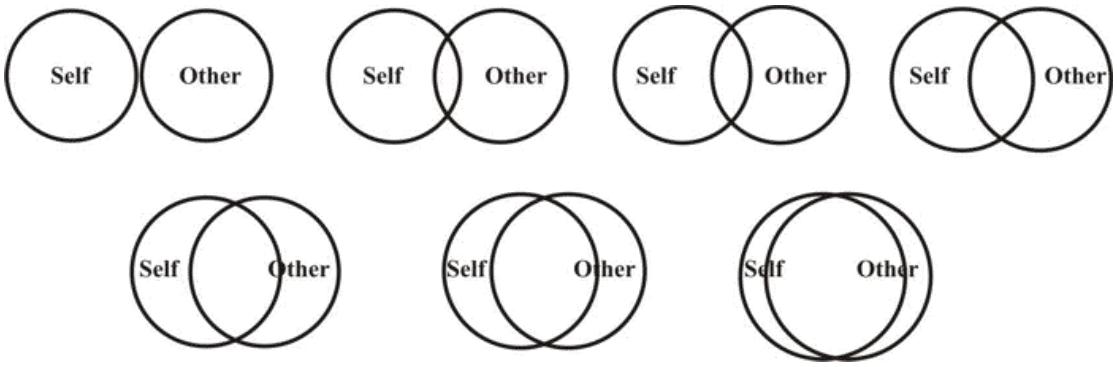
Email D.J.Gooch@bath.ac.uk

E.2 Diary Pages

How do you feel about your partner/relationship today? If you communicated with your partner today, how did it make you feel? Did it last all day? Did you use the SleepyWhispers today? Why? How did it compare to how you normally communicate with your partner?

12th March
Pre-Use Data Collection

How close do you feel to your partner today?



Date and Time:_____

How did you contact (or were contacted by) your partner?

○ Face to Face	○ Telephone	○ SleepyWhispers
○ Instant Messenger	○ Skype with Voice	○ Email
○ SMS	○ Skype with Video	○ Other (Please Describe)

Briefly say what you talked/wrote about:

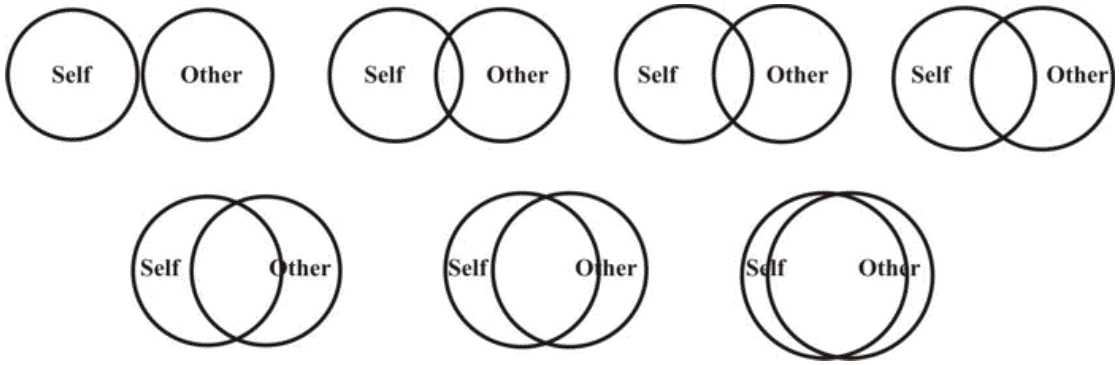
How did it make you feel and why?

Did this exchange make you feel appreciated? Why?

How would you describe the exchange? For each pair of words, please rate how you would describe the contact.

	3	2	1	0	1	2	3	
Impersonal								Personal
Cold								Warm
Ugly								Beautiful
Small								Large
Insensitive								Sensitive
Colourless								Colourful
Unsociable								Sociable
Closed								Open
Passive								Active

How close do you now feel to your partner?



Appendix F

SleepyWhispers Material

In addition to the Social Presence scales, the contact diary asked for three other pieces of information – what they talked/wrote about, how it made them feel and why and also whether (and why) the exchange made them feel appreciated.

This data was independently coded by two coders. The topics of conversation were found to consist of:

- Our Days/Catch-Up
- Were Together
- Information Exchange
- Humour
- Ping

Our Days/Catch-Up was generally characterised by talk about holidays, other plans, pK's new flat and work.

An inter-rater reliability analysis using the Kappa statistic was performed to determine consistency among raters (Kappa = 0.944 ($p < 0.001$)).

There were a substantial number of feelings that were discussed, more than we anticipated given the granularity of the conversation topics. The ten key emotions were:

- Happy
- Sharing & Being Involved
- Anticipation & Excitement
- Time Pressure (Tired/Distracted/Rushed)
- Seeing Each Other
- Information Exchange
- Thoughtful
- Humour
- Sad/Upset
- Guilty/Disappointed

An inter-rater reliability analysis using the Kappa statistic was performed to determine consistency among raters (Kappa = 0.882 ($p < 0.001$)).

'Humour' appearing as both a Conversation Topic and Feeling again highlights it's significance to the couple.

Appreciation had a very clear breakdown of answers:

- Yes
- Yes (with a reason)
- No more than usual
- Negative

Although the reasons were coded, there were so many of them (5 reasons) in proportion to the size of the data set that no meaningful analysis could be run on them separately from the 'Yes (with a reason)' category.

An inter-rater reliability analysis using the Kappa statistic was performed to determine consistency among raters (Kappa = 0.911 ($p < 0.001$)).

Appendix F.1 through F.3 describe the progression of the coding themes.

The coding of these three facets of communication is not that interesting in of itself. What we want to know is how/if the three facets are connected, whether they are connected to the use of a particular communication media and what their impact on feelings of SP are.

The correct test to perform in these circumstances would be to run a Chi Square test for correlation between each of the three facets. Unfortunately, the size of the data compared to the number of categories means that such a test cannot be performed correctly.

Instead, section F.4 shows the raw data of the crosstabulations between the three facets.

Looking at the data, there appears to be a general bias towards feeling appreciated with no clear distinction across conversation topic, communication media or emotion. sleepyWhispers appears to be exceptional, with a particular emphasis on appreciation with a reason.

There is also a 3-way connection between Communication Media, Conversation Topic and Feelings. Tables F.1 and F.2 take the data from the crosstabulations and present the clearest connections in terms of the associations between categories.

Communication Media and Feelings		**Communication Media and Conversation**		**Conversation and Feelings**	
Telephone	Happy, Sharing & Being Involved, Time Pressure	Telephone	Our Days/Catch-Up	Our Days/Catch-Up	Happy, Sharing & Being Involved, Time Pressure
Face-to-Face	Seeing Each Other	Face-to-Face	Were Together	Were Together	Seeing Each Other
sleepyWhispers	Humour, Thoughtful	sleepyWhispers	Humour	Humour	Humour, Thoughtful

Table F.1: pZ Associations between Conversation Topics, Feelings and Communication Media

Communication Media and Feelings		**Communication Media and Conversation**		**Conversation and Feelings**	
Face-to-Face	Seeing Each Other	Face-to-Face	Our Days/, Were Catch-Up, Together	Our Days/, Were Catch-Up, Together	Seeing Each Other
sleepyWhispers	Humour	sleepyWhispers	Humour	Humour	Humour
Telephone Telephone	Happy, Sharing & Being Involved	Telephone Telephone	Our Days/ Catch-Up	Our Days/ Catch-Up	Happy, Sharing & Being Involved
SMS SMS	Information Exchange	SMS SMS	Information Exchange	Information Exchange	Information Exchange

Table F.2: pK Associations between Conversation Topics, Feelings and Communication Media

We can't determine whether this is a causal link, all we can determine is that there appears to me an association between the three categories. We do not meet the assumptions for either a Chi Square test nor a Linear Regression so can make no more claims about the association.

The reason for investigating this association is that the three facets show some indication of having an impact of feelings of SP. Tables F.3 and F.4 show the results of performing a Kruskall-Wallis test on each of the facets against SP. Table F.5 presents the Mean Rank results for each of these tests.

In each case (whether significant or not), the results match what you might expect. In terms of association, there is a decrease in SP from communication acts where the responder felt appreciated to those where they did not. The only surprising results from this is that the acts with a known reason for feeling appreciated did not score higher than those without a reason.

The conversation topics were divided by those which might be termed 'Emotional' (i.e. 'Our Days/Catch-Up', 'Were Together' and 'Humour') which were associated with higher levels of SP as compared to those topics which were more routine (i.e. 'Information Exchange' and 'Ping').

The Feelings categories again match expectations; 'Seeing Each Other' is notable for being the highest ranked category whereas 'Time Pressure', 'Information Exchange', 'Sad/Upset' and 'Guilty/Disappointed' are all associated with low levels of SP.

These statistics suggest that all three facets have an impact on SP. However, the association between them (and conversation media) indicates that the true cause of impact on SP is likely to be some combination of the four factors. Again, without a Linear Regression it is impossible to determine which factor is actually having an impact on the participants' feelings of SP.

This finding relates to the claims we made in Section T regarding our definition of SP. As a concept, SP is not only determined by the communication medium being used and the impact of the particular medium is also dependent on how it is used.

Topic	**n**	**Test Statistic**	**p**	**Significant?**
Conversation	51	$H(4) = 20.411$	$p < 0.001$	**Yes**
Feeling	51	$H(9) = 29.144$	$p = 0.001$	**Yes**
Appreciation	51	$H(2) = 5.168$	$p = 0.075$	No

Table F.3: Kruskall-Wallis results for Conversation Topic, Feeling, Appreciation by pZ's SP scores

Topic	**n**	**Test Statistic**	**p**	**Significant?**
Conversation	48	$H(4) = 5.524$	$p = 0.238$	No
Feeling	48	$H(8) = 13.475$	$p = 0.097$	No
Appreciation	48	$H(3) = 16.490$	$p = 0.001$	**Yes**

Table F.4: Kruskall-Wallis results for Conversation Topic, Feeling, Appreciation by pK's SP scores

Topic	pZ			pK		
	n	Topic	Mean Rank SP	n	Topic	Mean Rank SP
Conversation	51	Our Days/ Catch-Up	30.21	48	Our Days/ Catch-Up	25.05
		Were Together	49.50		Were Together	35.50
		Information Exchange	13.70		Information Exchange	15.75
		Humour	24.75		Humour	26.83
		Ping	8.93		Ping	19.17
Feelings	51	Happy	32.11	48	Happy	20.72
		Sharing & Being Involved	29.07		Sharing & Being Involved	27.90
		Anticipation & Excitement	33.00		Anticipation & Excitement	28.50
		Time Pressure	13.18		Time Pressure	1.50
		Seeing Each Other	46.17		Seeing Each Other	35.92
		Information Exchange	7.00		Information Exchange	17.31
		Thoughtful	24.29		Thoughtful	-
		Humour	30.10		Humour	27.75
		Sad/Upset	5.50		Sad/Upset	3.00
		Guilty/ Disappointed	7.00		Guilty/ Disappointed	22.25
Appreciation	51	Yes	30.95	48	Yes	42.50
		Yes (with a reason)	25.97		Yes (with a reason)	31.90
		No more than usual	18.81		No more than usual	18.63
		Negative	-		Negative	14.14

Table F.5: Mean Ranks for SP Scores for each Participant by Conversation Topic, Feeling and Appreciation Coding

First Set	Second Set
Our Days	Our Days/Catch Up
Catch Up	⇑
Recommendation	⇑
New Flat	⇑
Work	⇑
Holiday	⇑
Plans	⇑
Were Together	Were Together
Information Exchange	Information Exchange
Ping	Ping
Humour	Humour
sleepyWhispers Message	⇑

Table F.6: Coding of Conversation Topics

F.1 Conversation Coding

F.2 Feelings Coding

First Set	Second Set	Third Set
Happy	Happy	Happy
Sharing & Being Involved	Sharing & Being Involved	Sharing & Being Involved
Reassured	Reassured	⇑
Anticipation & Excitement	Anticipation & Excitement	Anticipation & Excitement
Tired/Distracted	Time Pressure	Time Pressure
Rushed	⇑	
Distracted	⇑	
Seeing Each Other	Seeing Each Other	Seeing Each Other
Information Exchange	Information Exchange	Information Exchange
Thoughtful	Thoughtful	Thoughtful
Empathy/useful	⇑	
Humour	Humour	Humour
Stupid	⇑	
Sad	Sad/Upset	Sad/Upset
Upset	⇑	
Guilty/Bad	Guilty/Disappointed	Guilty/Disappointed
Disappointed	⇑	
Confused	*Removed*	
n/a	n/a	*Removed*

Table F.7: Coding of Feeling Topics

F.3 Appreciation Coding

First Set	Second Set
Included	Shared Experience/Being Involved
Sharing	⇑
Organise	⇑
Wanted	Feeling Wanted
Effort	⇑
Opinion	⇑
Interest	Expression of Interest/Concern
Concern	⇑
Pleased	Positive Emotion (Enjoy/Laugh/Pleased)
Laugh	⇑
Enjoy	⇑
Memory	Memory

Table F.8: Coding of Appreciation Topics

F.4 Crosstabulations of Feelings, Conversation Topic, Appreciation and Communication Media

Feelings	**Communication Media**						**Total**
	Telephone	**Face to Face**	**SMS**	**Email**	**sleepyWhispers**	**IM**	
Happy	9	0	0	0	0	0	9
Sharing & Being Involved	5	0	1	0	0	1	7
Anticipation & Excitement	2	0	0	0	0	0	2
Time Pressure	10	0	1	0	0	0	11
Seeing Each Other	0	6	0	0	0	0	6
Information Exchange	0	0	0	1	0	0	1
Thoughtful	1	0	3	1	2	0	7
Humour	2	0	0	0	3	0	5
Sad/Upset	1	0	1	0	0	0	2
Guilty/ Disappointed	0	0	1	0	0	0	1
Total	30	6	7	2	5	1	51

Table F.9: Crosstabulation of pZ's data, showing Feelings against Communication Media

Feelings	**Communication Media**				**Total**
	Telephone	**Face to Face**	**SMS**	**sleepyWhispers**	
Happy	8	0	1	0	9
Sharing & Being Involved	13	1	1	0	15
Anticipation & Excitement	2	0	0	0	2
Time Pressure	1	0	0	0	1
Seeing Each Other	0	6	0	0	6
Information Exchange	5	0	3	0	8
Humour	2	0	0	2	4
Sad/Upset	1	0	0	0	1
Guilty/ Disappointed	2	0	0	0	2
Total	34	7	5	2	48

Table F.10: Crosstabulation of pK's data, showing Feelings against Communication Media

Conversation Topics	**Communication Media**						**Total**
	Telephone	**Face to Face**	**SMS**	**Email**	**sleepy--Whispers**	**IM**	
Our Days/ Catch Up	28	0	1	0	0	0	29
Were Together	0	6	0	0	0	0	6
Information Exchange	0	0	1	2	1	1	5
Humour	0	0	0	0	4	0	4
Ping	2	0	5	0	0	0	7
Total	30	6	7	2	5	1	51

Table F.11: Crosstabulation of pZ's data, showing Conversation Topic against Communication Media

Conversation Topics	**Communication Media**				**Total**
	Telephone	**Face to Face**	**SMS**	**sleepyWhispers**	
Our Days/Catch Up	29	3	0	0	32
Were Together	0	4	0	0	4
Information Exchange	2	0	4	0	6
Humour	0	0	1	2	3
Ping	3	0	0	0	3
Total	34	7	5	2	48

Table F.12: Crosstabulation of pK's data, showing Conversation Topic against Communication Media

Feelings	**Conversation Topic**					**Total**
	Our Days/ Catch Up	**Were Together**	**Information Exchange**	**Humour**	**Ping**	
Happy	9	0	0	0	0	9
Sharing & Being Involved	5	0	2	0	0	7
Anticipation & Excitement	2	0	0	0	0	2
Time Pressure	8	0	0	0	3	11
Seeing Each Other	0	6	0	0	0	6
Information Exchange	0	0	1	0	0	1
Thoughtful	2	0	1	2	2	7
Humour	2	0	1	2	0	5
Sad/Upset	1	0	0	0	1	2
Guilty/ Disappointed	0	0	0	0	1	1
Total	29	6	5	4	7	51

Table F.13: Crosstabulation of pZ's data, showing Feelings against Conversation Topic

Feelings	**Conversation Topic**					**Total**
	Our Days/ Catch Up	**Were Together**	**Information Exchange**	**Humour**	**Ping**	
Happy	7	0	0	1	1	9
Sharing & Being Involved	13	0	1	0	1	15
Anticipation & Excitement	2	0	0	0	0	2
Time Pressure	1	0	0	0	0	1
Seeing Each Other	2	4	0	0	0	6
Information Exchange	3	0	5	0	0	8
Humour	2	0	0	2	0	4
Sad/Upset	1	0	0	0	0	1
Guilty/ Disappointed	1	0	0	0	1	2
Total	32	4	6	3	3	48

Table F.14: Crosstabulation of pK's data, showing Feelings against Conversation Topic

Feelings	**Appreciation**			**Total**
	Yes	**Yes with a Reason**	**No More Than Usual**	
Happy	3	2	4	9
Sharing & Being Involved	4	2	1	7
Anticipation & Excitement	1	1	0	2
Time Pressure	3	3	5	11
Seeing Each Other	3	3	0	6
Information Exchange	0	0	1	1
Thoughtful	3	2	2	7
Humour	1	4	0	5
Sad/Upset	0	2	0	2
Guilty/ Disappointed	1	0	0	1
Total	19	19	13	51

Table F.15: Crosstabulation of pZ's data, showing Feelings against Appreciation Reasons

Feelings	Appreciation				Total
	Yes	Yes with a Reason	No More Than Usual	Negative	
Happy	0	2	7	0	9
Sharing & Being Involved	0	12	2	1	16
Anticipation & Excitement	0	0	1	1	2
Time Pressure	0	0	0	1	1
Seeing Each Other	2	3	1	0	6
Information Exchange	0	1	6	1	8
Humour	0	2	2	0	4
Sad/Upset	0	0	0	1	1
Guilty/ Disappointed	0	0	0	2	2
Total	2	20	19	7	48

Table F.16: Crosstabulation of pK's data, showing Feelings against Appreciation Reasons

Appreciation	Conversation Topic					Total
	Our Days/ Catch Up	Were Together	Information Exchange	Humour	Ping	
Yes	12	3	1	1	2	19
Yes with a Reason	8	3	2	3	3	19
No More Than Usual	9	0	2	0	2	13
Total	29	6	5	4	7	51

Table F.17: Crosstabulation of pZ's data, showing Feelings of Appreciation against Conversation Topic

Appreciation	Conversation Topic					Total
	Our Days/ Catch Up	Were Together	Information Exchange	Humour	Ping	
Yes	1	1	0	0	0	2
Yes with a Reason	15	2	1	1	1	20
No More Than Usual	11	1	4	2	1	19
Negative	5	0	1	0	1	7
Total	32	4	6	3	3	48

Table F.18: Crosstabulation of pK's data, showing Feelings of Appreciation against Conversation Topic

Appreciation	**Communication Media**						**Total**
	Telephone	**Face to Face**	**SMS**	**Email**	**sleepy--Whispers**	**IM**	
Yes	12	3	3	0	1	0	19
Yes with a Reason	9	3	2	0	4	1	19
No More Than Usual	9	0	2	2	0	0	13
Total	30	6	7	2	5	1	51

Table F.19: Crosstabulation of pZ's data, showing Feelings of Appreciation against Communication Media

Appreciation	**Communication Media**				**Total**
	Telephone	**Face to Face**	**SMS**	**sleepyWhispers**	
Yes	0	2	0	0	2
Yes with a Reason	14	4	1	1	20
No More Than Usual	13	1	4	1	19
Negative	7	0	0	0	7
Total	34	7	5	2	48

Table F.20: Crosstabulation of pK's data, showing Feelings of Appreciation against Communication Media

Appendix G

HotMitts Material

In addition to the SP scales, the contact diary asked for three other pieces of information – what they talked/wrote about, how it made them feel and why and also whether (and why) the exchange made them feel appreciated.

This data was independently coded by two coders. The topics of conversation were found to consist of:

- Our Days/Catch-Up
- Work
- Ping
- Being Together
- Arguments
- Plans for being together
- Special Occasions
- Relational Activities

An inter-rater reliability analysis using the Kappa statistic was performed to determine consistency among raters (Kappa = 0.905 ($p < 0.001$)).

There were a substantial number of feelings that were discussed, more than we anticipated given the granularity of the conversation topics. The ten key emotions were:

- Very Happy
- Happy
- Cared For/Involved
- Excited
- Helpful
- Relaxed
- Neutral
- Upset
- Relational Strain
- Annoyed

An inter-rater reliability analysis using the Kappa statistic was performed to determine consistency among raters (Kappa = 0.908 ($p < 0.001$)).

Appreciation had a very clear breakdown of answers:

- Yes
- Yes (with a reason)
- No more than usual
- No
- No (with a reason)

An inter-rater reliability analysis using the Kappa statistic was performed to determine consistency among raters (Kappa = 0.950 ($p < 0.001$)).

The appreciation reasons had a less clear break-down but the eight which were selected for further analysis were:

- Being Together
- Caring about each other
- Sharing Things
- Expression of Effort
- Coming Home
- Unimportant
- Arguing
- Upset

An inter-rater reliability analysis using the Kappa statistic was performed to determine consistency among raters (Kappa = 0.754 ($p < 0.001$)).

Sections G.1 through G.3 describe the progression of the coding themes.

The coding of these three facets of communication is not that interesting in of itself. What we want to know is how/if the three facets are connected, whether they are connected to the use of a particular communication media and what their impact on feelings of Social Presence are.

The correct test to perform in these circumstances would be to run a Chi Square test for correlation between each of the three facets. Unfortunately, the size of the data compared to the number of categories means that such a test cannot be performed correctly.

Instead, Section G.4 shows the raw data of the crosstabulations between the three facets.

Looking at the data, there appears to be a general bias towards using Skype (with Video) but there is no clear distinction across conversation topic, appreciation or emotion by communication media. Similarly, most conversations are biased towards "Our Days/Catch Up" but show no clear distinction across communication media, appreciation or emotion.

There appears to be a weak association between appreciation and feelings. Feeling appreciated is associated with positive emotions (e.g. Happy, Very Happy, Cared For/Involved) and not feeling appreciated being associated with negative emotions (e.g. Upset, Annoyed, Relational Strain).

There also appears to be a weak association between conversation topics and feelings. Arguments were typified by feeling upset (or relational strain), Plans for being together caused a level of excitement and Being Together or talking about Our Days were strongly associated with feeling happy.

We can't determine whether this is a causal link; all we can determine is that there appears to me an association between the three categories. We the data does not meet the assumptions for running either a Chi Square test or a Linear Regression we can make no more claims about the association.

The reason for investigating this association is that the three facets show some indication of having an impact of feelings of SP. Tables G.1 and G.2 show the results of performing a Kruskall-Wallis test on each of the facets against SP and Closeness. Tables G.3 through G.6 presents the Mean Rank results for each of these tests.

In each case (whether significant or not), the results match what you might expect. In terms of appreciation, there is a decrease in SP from communication acts where the responder felt appreciated to those where they did not. The reasons for feeling appreciated are also unsurprising; Being Together was associated with the highest levels of SP whereas negative reasons (feeling Unimportant, Arguing or Upset) were associated with the lowest levels of SP.

The conversation topics were divided by those which might be termed 'Emotional' (i.e. 'Being Together', 'Special Occasions') which were associated with higher levels of SP as compared to those topics which were more routine (i.e. 'Ping' and 'Arguments'). The other conversation topics were associated with middling levels of SP.

The Feelings categories again match expectations; 'Very Happy' is notable for being the highest ranked category whereas 'Relational Strain', 'Annoyed' and 'Upset' are all associated with low levels of SP.

These statistics suggest that all three facets have an impact on SP. However, the association between them (and conversation media) indicates that the true cause of impact on SP is likely to be some combination of the four factors. Again, without a Linear Regression it is impossible to determine which factor is actually having an impact on the participants' feelings of SP.

This finding relates to the claims we made in Chapters 2 and 4 regarding our definition of SP. As a concept, SP is not only determined by the communication medium being used and the impact of the particular medium is also dependent on how it is used.

Topic	**n**	**Test Statistic**	**p**	**Significant?**
Conversation	70	$H(7) = 31.668$	$p < 0.001$	**Yes**
Feeling	70	$H(8) = 17.887$	$p = 0.022$	**Yes**
Appreciation	70	$H(4) = 26.696$	$p < 0.001$	**Yes**
Appreciation Reason	70	$H(7) = 29.039$	$p < 0.001$	**Yes**

Table G.1: Kruskall-Wallis results for Conversation Topic, Feeling, Appreciation by pM's SP scores

Topic	**n**	**Test Statistic**	**p**	**Significant?**
Conversation	82	$H(7) = 46.877$	$p < 0.001$	**Yes**
Feeling	82	$H(7) = 25.044$	$p < 0.001$	**Yes**
Appreciation	82	$H(2) = 20.530$	$p < 0.001$	**Yes**
Appreciation Reason	82	$H(7) = 43.395$	$p < 0.001$	**Yes**

Table G.2: Kruskall-Wallis results for Conversation Topic, Feeling, Appreciation by pT's SP scores

Topic	pM			pT		
	n	**Topic**	**Mean Rank SP**	**n**	**Topic**	**Mean Rank SP**
Conversation	31	Our Days/ Catch-Up	31.60	32	Our Days/ Catch-Up	34.41
	8	Work	45.44	9	Work	31.94
	5	Ping	18.20	3	Ping	27.67
	10	Being Together	55.15	21	Being Together	69.52
	5	Arguments	3.60	4	Arguments	3.88
	3	Plans for being together	40.67	4	Plans for being together	43.25
	5	Special Occasions	51.20	6	Special Occasions	31.33
	3	Relational Activities	34.50	3	Relational Activities	31.67

Table G.3: Mean Ranks for SP Scores for each Participant by Conversation Topic

Topic	pM			pT		
	n	**Topic**	**Mean Rank SP**	**n**	**Topic**	**Mean Rank SP**
Feelings	6	Very Happy	57.92	8	Very Happy	64.50
	35	Happy	34.73	40	Happy	42.34
	5	Cared For/ Involved	41.80	7	Cared For/ Involved	57.64
	3	Excited	36.17	4	Excited	47.12
	6	Helpful	39.25	-	-	-
	3	Relaxed	38.17	3	Relaxed	18.50
	2	Neutral	34.75	-	-	-
	5	Upset	29.10	10	Upset	36.80
	5	Relational Strain	7.90	6	Relational Strain	13.33
	-	-	-	4	Annoyed	24.50

Table G.4: Mean Ranks for SP Scores for each Participant by Feeling

Topic	pM			pT		
	n	**Topic**	**Mean Rank SP**	**n**	**Topic**	**Mean Rank SP**
Appreciation	2	Yes	36.00	7	Yes	46.71
	50	Yes (With a reason)	42.69	67	Yes (With a reason)	45.24
	8	No more than usual	24.44	-	-	-
	4	No	6.75	-	-	-
	6	No (With a reason)	9.33	8	No (With a reason)	5.62

Table G.5: Mean Ranks for SP Scores for each Participant by Appreciation

G.1 Conversation Coding

Topic	pM			pT		
	n	**Topic**	**Mean Rank SP**	**n**	**Topic**	**Mean Rank SP**
Appreciation Reason	10	Being Together	46.90	20	Being Together	60.45
	8	Caring about each other	32.38	18	Caring about each other	31.81
	26	Sharing Things	28.02	6	Sharing Things	43.00
	4	Expression of Effort	14.62	19	Expression of Effort	31.47
	2	Coming Home	25.25	2	Coming Home	44.75
	1	Unimportant	1.00	7	Unimportant	5.71
	2	Arguing	2.50	1	Arguing	4.50
	3	Upset	8.17	2	Upset	39.25

Table G.6: Mean Ranks for SP Scores for each Participant by Appreciation Reason

First Set	Second Set
Our Days	Our Days/Catch Up
Catch-Up	⇑
Work	Work
Exam	⇑
Interview	⇑
Ping	Ping
Wake-Up	⇑
Being Together	Being Together
Argument	Argument
Plans for Being Together	Plans for Being Together
Organising	⇑
Coming Home	⇑
Special Occasion	Special Occasion
The Relationship	Relational Activities
Upset	⇑
Nightmare	⇑
Cheer-Up	⇑
Feelings	⇑
A friend/social circle	⇑
Made-Up	⇑

Table G.7: Coding of Conversation Topics

G.2 Feelings Coding

First Set	Second Set	Third Set
Very Happy	Very Happy	Very Happy
Happy	Happy	Happy
Content	⇑	
Warm	⇑	
Pleased	⇑	
Nice	⇑	
Cheerful	⇑	
Glad	⇑	
Amused	Amused	⇑
Laugh	⇑	
Cared About	Cared For/Involved	Cared For/ Involved
Involved	⇑	
Close	⇑	
Loved	⇑	
Surprised	⇑	
Proud	⇑	
Supported	⇑	
Excited	Excited	Excited
Helpful	Helpful	Helpful
Relieved	⇑	
Useful	⇑	
Relaxed	Relaxed	Relaxed
Calmer	⇑	
Neutral	Neutral	Neutral
No Closer	⇑	
Upset	Upset	Upset
Sad	⇑	
Unhappy	⇑	
Fed-Up	⇑	
Very Upset	Very Upset	⇑
Devastated	⇑	
Guilty	Relational Strain	Relational Strain
Missing Them	⇑	
Jealous	⇑	
Arguing	Arguing	⇑
Ignored	Ignored	⇑
Left Out	⇑	
Hurried	⇑	
Helpless	Helpless	⇑
Useless	⇑	
Annoyed	Annoyed	Annoyed

Table G.8: Coding of Emotional Topics

G.3 Appreciation Coding

First Set	Second Set	Third Set
Being together	Being Together	Being Together
Appreciate Company	⇑	
Getting on Together	⇑	
Cared about me	Caring About Each Other	Caring About Each Other
Expression of Concern	⇑	
Belonging	⇑	
Feel Special	⇑	
Supported	⇑	
Reassured	⇑	
Needed	⇑	
Reassuring	⇑	
Missed	⇑	
Calmed Down	⇑	
Interested	⇑	
Thankful	⇑	
Wanted	⇑	
Happy	Making Me Happy	⇑
Cheer-Up	⇑	
Laugh	⇑	
Happy	⇑	
Excited	⇑	
Sharing	Sharing things	Sharing things
Compliment	⇑	
Caring	⇑	
Important	⇑	
Birthday	⇑	
Chat	⇑	
Pleased to Talk	⇑	
Future	⇑	
Effort	Expression of Effort	Expression of Effort
Helping	⇑	
Thoughtful	⇑	
Helping	⇑	
Coming Home	Coming Home	Coming Home
Unimportant	Unimportant	Unimportant
Uncaring	⇑	
Ignoring	Ignoring	⇑
Distracted	Distracted	⇑
Arguing	Arguing	Arguing
Angry	⇑	
Fighting	⇑	
Annoyed	⇑	
Upset	Upset	Upset
Grumpy	⇑	

Table G.9: Coding of Appreciation Topics

G.4 Crosstabulations of Feelings, Conversation Topic, Appreciation and Communication Media

Feelings	**Communication Media**					**Total**
	Face to Face	**IM**	**Telephone**	**Skype (with video)**	**hotMitts**	
Very Happy	5	0	1	2	0	8
Happy	7	1	5	26	1	40
Cared For/ Involved	5	0	2	0	0	7
Excited	0	0	1	3	0	4
Relaxed	0	0	0	2	1	3
Upset	3	0	1	6	0	10
Relational Strain	0	0	0	5	1	6
Annoyed	1	0	0	3	0	4
Total	21	1	10	47	3	82

Table G.10: Crosstabulation of pT's data showing Feelings against Communication Media

Feelings	**Communication Media**					**Total**
	Face to Face	**IM**	**Telephone**	**Skype (with video)**	**hotMitts**	
Very Happy	5	0	1	0	0	6
Happy	2	1	6	25	1	35
Cared For/ Involved	0	0	0	5	0	5
Excited	0	0	0	3	0	3
Helpful	0	0	2	4	0	6
Relaxed	1	0	0	2	0	3
Neutral	0	0	0	1	1	2
Upset	1	0	1	3	0	5
Relational Strain	1	0	0	3	1	5
Total	10	1	10	46	3	70

Table G.11: Crosstabulation of pM's data showing Feelings against Communication Media

Conversation Topics	Communication Media					Total
	Face to Face	IM	Telephone	Skype (with Video)	hotMitts	
Our Days/ Catch Up	0	0	3	27	2	32
Work	0	1	1	7	0	9
Ping	0	0	3	0	0	3
Being Together	21	0	0	0	0	21
Argument	0	0	1	2	1	4
Plans for being together	0	0	0	4	0	4
Special Occasions	0	0	1	5	0	6
Relational Activities	0	0	1	2	0	3
Total	21	1	10	47	3	82

Table G.12: Crosstabulation of pT's data showing Conversation Topic against Communication Media

Conversation Topics	Communication Media					Total
	Face to Face	IM	Telephone	Skype (with Video)	hotMitts	
Our Days/ Catch Up	0	0	3	26	2	31
Work	0	1	1	6	0	8
Ping	0	0	3	2	0	5
Being Together	10	0	0	0	0	10
Argument	0	0	1	3	1	5
Plans for being together	0	0	0	3	0	3
Special Occasions	0	0	1	4	0	5
Relational Activities	0	0	1	2	0	3
Total	10	1	10	46	3	70

Table G.13: Crosstabulation of pM's data showing Conversation Topic against Communication Media

Feelings	Conversation Topic								
	Our Days/ Catch Up	**Work**	**Ping**	**Being Together**	**Arguments**	**Plans For Being Together**	**Special Occasions**	**Relational Activities**	**Total**
Very Happy	2	1	0	5	0	0	0	0	8
Happy	24	4	2	7	0	1	1	1	40
Cared For/Involved	0	0	1	5	0	0	0	1	7
Excited	0	0	0	0	0	3	1	0	4
Relaxed	1	2	0	0	0	0	0	0	3
Upset	2	1	0	3	1	0	3	0	10
Relational Strain	0	1	0	0	3	0	1	1	6
Annoyed	3	0	0	1	0	0	0	0	4
Total	32	9	3	21	4	4	6	3	82

Table G.14: Crosstabulation of pT's data showing Feelings against Conversation Topic

Feelings	Conversation Topic								
	Our Days/ Catch Up	**Work**	**Ping**	**Being Together**	**Arguments**	**Plans For Being Together**	**Special Occasions**	**Relational Activities**	**Total**
Very Happy	1	0	0	5	0	0	0	0	6
Happy	19	5	5	2	0	0	3	1	35
Cared For/Involved	2	1	0	0	0	1	0	1	5
Excited	0	0	0	0	0	2	1	0	3
Helpful	3	2	0	0	0	0	0	1	6
Relaxed	2	0	0	1	0	0	0	0	3
Neutral	2	0	0	0	0	0	0	0	2
Upset	1	0	0	1	2	0	1	0	5
Relational Strain	1	0	0	1	3	0	0	0	5
Total	31	8	5	10	5	3	5	3	70

Table G.15: Crosstabulation of pM's data showing Feelings against Conversation Topic

Feelings	**Appreciation**			**Total**
	Yes	**Yes with a Reason**	**No with a Reason**	
Very Happy	0	8	0	8
Happy	5	35	0	40
Cared For/Involved	1	6	0	7
Excited	0	4	0	4
Relaxed	0	3	0	3
Upset	1	7	2	10
Relational Strain	0	2	4	6
Annoyed	0	2	2	4
Total	7	67	8	82

Table G.16: Crosstabulation of pT's data showing Feelings against Appreciation

Feelings	**Appreciation**					**Total**
	Yes	**Yes with a Reason**	**No More Than Usual**	**No**	**No with a Reason**	
Very Happy	0	5	1	0	0	6
Happy	1	28	4	1	1	35
Cared For/Involved	0	4	1	0	0	5
Excited	0	3	0	0	0	3
Helpful	1	5	0	0	0	6
Relaxed	0	2	1	0	0	3
Neutral	0	2	0	0	0	2
Upset	0	1	1	1	2	5
Relational Strain	0	0	0	2	3	5
Total	2	50	8	4	6	70

Table G.17: Crosstabulation of pM's data showing Feelings against Appreciation

Appreciation	Conversation Topic								
	Our Days/ Catch Up	**Work**	**Ping**	**Being Together**	**Arguments**	**Plans For Being Together**	**Special Occasions**	**Relational Activities**	**Total**
Yes	4	0	1	2	0	0	0	0	7
Yes with a Reason	26	9	2	19	0	4	4	3	67
No with a Reason	2	0	0	0	4	0	2	0	8
Total	32	9	3	21	4	4	6	3	82

Table G.18: Crosstabulation of pT's data showing Appreciation against Conversation Topic

Appreciation	Conversation Topic								
	Our Days/ Catch Up	**Work**	**Ping**	**Being Together**	**Arguments**	**Plans For Being Together**	**Special Occasions**	**Relational Activities**	**Total**
Yes	2	0	0	0	0	0	0	0	2
Yes with a Reason	20	8	3	8	0	3	5	3	50
No more than usual	7	0	1	0	0	0	0	0	8
No	0	0	1	0	3	0	0	0	4
No with a Reason	2	0	0	2	2	0	0	0	6
Total	31	8	5	10	5	3	5	3	70

Table G.19: Crosstabulation of pM's data showing Appreciation against Conversation Topic

Appreciation	**Communication Media**					**Total**
	Face to Face	**IM**	**Telephone**	**Skype (with Video)**	**hotMitts**	
Yes	2	0	1	3	1	7
Yes with a Reason	19	1	8	38	1	67
No with a Reason	0	0	1	6	1	8
Total	21	1	10	47	3	82

Table G.20: Crosstabulation of pT's data showing Appreciation against Communication Media

Appreciation	**Communication Media**					**Total**
	Face to Face	**IM**	**Telephone**	**Skype (with Video)**	**hotMitts**	
Yes	0	0	1	1	0	2
Yes with a Reason	8	1	5	34	2	50
No more than usual	0	0	1	7	0	8
No	0	0	2	2	0	4
No with a Reason	2	0	1	2	1	6
Total	10	1	10	46	3	70

Table G.21: Crosstabulation of pM's data showing Appreciation against Communication Media

Appendix H

doodleMessenger Material

In addition to the SP, the contact diary asked for three other pieces of information – what they talked/wrote about, how it made them feel and why and also whether (and why) the exchange made them feel appreciated.

This data was independently coded by two coders. After checking the codings for inter-rater reliability, those cases which were rated differently, were discussed and a compromise reached. The topics of conversation were found to consist of:

- Chit-Chat/Our Days
- Work/Jobs
- Relational Communication
- Being Together
- Plans for visiting each other
- Ping
- n/a

An inter-rater reliability analysis using the Kappa statistic was performed to determine consistency among raters (Kappa = 0.519 ($p < 0.001$)).

There were a substantial number of feelings that were discussed, more than we anticipated given the granularity of the conversation topics. The key emotions were:

- Happy
- Fun/Amused
- Better
- Excited
- Cared For
- Seeing each other
- Missing each other
- n/a
- Upset/Guilty
- Annoyed

An inter-rater reliability analysis using the Kappa statistic was performed to determine consistency among raters (Kappa = 0.705 ($p < 0.001$)).

Appreciation had a very clear breakdown of answers:

- Yes
- Yes (with a reason)
- Ish
- Ish (with a reason)
- Neutral
- No
- No (with a reason)

An inter-rater reliability analysis using the Kappa statistic was performed to determine consistency among raters (Kappa = 0.750 ($p < 0.001$)).

The appreciation reasons had a less clear break-down but the eight which were selected for further analysis were:

- Being Involved/Together
- Taking the time/effortful
- Thoughtful
- Unimportant
- Cared For/Supported
- Being Missed
- Anticipation
- Moaned at

An inter-rater reliability analysis using the Kappa statistic was performed to determine consistency among raters (Kappa = 0.439 ($p < 0.001$)).

Sections H.1 through H.3 describe the progression of the coding themes.

The coding of these three facets of communication is not that interesting in of itself. What we want to know is how/if the three facets are connected, whether they are connected to the use of a particular communication media and what their impact on feelings of SP and Closeness are.

The correct test to perform in these circumstances would be to run a Chi Square test for correlation between each of the three facets. Unfortunately, the size of the data compared to the number of categories means that such a test cannot be performed correctly.

Instead, Section H.4 shows the raw data of the crosstabulations between the three facets.

Looking at the data, there appears to be a general bias towards using the telephone but there is no clear distinction across conversation topic, appreciation or emotion by communication media. Similarly, most conversations are biased towards "Chit-Chat/Our Days" but show no clear distinction across communication media, appreciation or emotion.

There appears to be a weak association between appreciation and feelings. Feeling appreciated is associated with positive emotions (e.g. Happy, Fun/Amused, Cared For, Seeing each other) and not feeling appreciated being associated with negative emotions (e.g. Upset/Guilty, Annoyed).

We can't determine whether this is a causal link; all we can determine is that there appears to me an association between the three categories. We the data does not meet the assumptions for running either a Chi Square test or a Linear Regression we can make no more claims about the association.

The reason for investigating this association is that the three facets show some indication of having an impact of feelings of SP. Tables H.1 and H.2 show the results of performing a Kruskall-Wallis test on each of the facets against Social Presence. Tables H.3 through H.6 presents the Mean Rank results for each of these tests.

In each case (whether significant or not), the results match what you might expect. In terms of appreciation, there is a decrease in SP from communication acts where the responder felt appreciated to those where they did not. The reasons for feeling appreciated are also unsurprising; Being Missed and Being Involved/Together was associated with the highest levels of SP whereas negative reasons (feeling Unimportant, being Moaned At) were associated with the lowest levels of SP.

The conversation topics were divided by those which might be termed 'Emotional' (i.e. 'Being Together') which were associated with higher levels of SP as compared to those topics which were more routine (i.e. 'n/a' and 'Work/Jobs'). The other conversation topics were associated with middling levels of SP.

The Feelings categories again match expectations; 'Seeing each other', 'Cared for' and 'Missing each other' are highly ranked whereas 'Annoyed' and 'Upset/Guilty' are all associated with low levels of SP.

These statistics suggest that all three facets have an impact on SP. However, the association between them (and conversation media) indicates that the true cause of impact on SP is likely to be some combination of the four factors. Again, without a Linear Regression it is impossible to determine which factor is actually having an impact on the participants' feelings of SP.

This finding relates to the claims we made in Section T regarding our definition of SP. As a concept, SP is not only determined by the communication medium being used and the impact of the particular medium is also dependent on how it is used.

Topic	**n**	**Test Statistic**	**p**	**Significant?**
Conversation	102	$H(6) = 33.112$	$p < 0.001$	**Yes**
Feeling	102	$H(9) = 54.564$	$p < 0.001$	**Yes**
Appreciation	102	$H(5) = 42.490$	$p < 0.001$	**Yes**
Appreciation Reason	61	$H(6) = 17.823$	$p = 0.007$	**Yes**

Table H.1: Kruskall-Wallis results for Conversation Topic, Feeling, Appreciation by pA's SP scores

Topic	**n**	**Test Statistic**	**p**	**Significant?**
Conversation	100	$H(6) = 29.526$	$p < 0.001$	**Yes**
Feeling	100	$H(9) = 49.295$	$p < 0.001$	**Yes**
Appreciation	100	$H(3) = 14.976$	$p = 0.002$	**Yes**
Appreciation Reason	63	$H(5) = 7.115$	$p = 0.212$	No

Table H.2: Kruskall-Wallis results for Conversation Topic, Feeling, Appreciation by pB's SP scores

Topic	pA			pB		
	n	Topic	Mean Rank SP	n	Topic	Mean Rank SP
Conversation	36	Chit-Chat/ Our Days	44.67	26	Chit-Chat/ Our Days	48.25
	16	Work/Jobs	42.72	16	Work/Jobs	50.31
	15	Relational Communication	49.67	20	Relational Communication	54.65
	12	Being Together	93.54	12	Being Together	86.71
	13	Plans for being together	46.54	11	Plans for being together	28.27
	5	Ping	69.30	9	Ping	39.17
	5	n/a	28.50	6	n/a	32.25

Table H.3: Mean Ranks for SP Scores for each Participant by Conversation Topic

Topic	pA			pB		
	n	Topic	Mean Rank SP	n	Topic	Mean Rank SP
Feelings	24	Happy	59.56	28	Happy	59.61
	12	Fun	49.92	17	Fun	45.50
	5	Better	44.80	7	Better	41.21
	6	Excited	41.67	9	Excited	49.00
	4	Cared For	69.00	5	Cared For	53.60
	16	Seeing Each Other	87.59	12	Seeing Each Other	91.42
	4	Missing Each Other	63.50	8	Missing Each Other	31.50
	16	n/a	27.13	7	n/a	25.29
	9	Upset/ Guilty	36.78	3	Upset/ Guilty	17.83
	6	Annoyed	9.00	4	Annoyed	7.63

Table H.4: Mean Ranks for SP Scores for each Participant by Feeling

Topic	pA			pB		
	n	Topic	Mean Rank SP	n	Topic	Mean Rank SP
Appreciation	48	Yes (With a reason)	70.48	61	Yes (With a reason)	59.05
	-	Yes	-	4	Yes	52.50
	10	Ish (With a reason)	42.95	-	Ish (With a reason)	-
	4	Ish	28.00	-	Ish	-
	35	Neutral	36.57	33	Neutral	35.77
	2	No	15.00	-	No	-
	3	No (With a reason)	6.17	2	No (With a reason)	28.75

Table H.5: Mean Ranks for SP Scores for each Participant by Appreciation

Topic	**pA**			**pB**		
	n	**Topic**	**Mean Rank SP**	**n**	**Topic**	**Mean Rank SP**
Appreciation Reason	23	Being Involved/ Together	39.41	17	Being Involved/ Together	37.82
	4	Taking the time/effort	22.75	7	Taking the time/effort	38.14
	8	Thoughtful	29.75	8	Thoughtful	24.25
	1	Unimportant	5.00	1	Unimportant	1.00
	20	Cared for/ Supported	27.68	27	Cared for/ Supported	30.11
	2	Being Missed	44.50	3	Being Missed	32.67
	-	Anticipation	-	-	Anticipation	-
	-	Poor Communication	-	-	Poor Communication	-
	3	Moaned At	2.67	-	Moaned At	-

Table H.6: Mean Ranks for SP Scores for each Participant by Appreciation Reason

H.1 Conversation Coding

First Set	**Second Set**
Chit-Chat	Chit-Chat/ Catch-Up
Catch-Up	⇑
Friends	⇑
Weekends	⇑
Nights Out	⇑
Being Drunk	⇑
The Weather	⇑
Family	⇑
Concerts	⇑
Theatre	⇑
Gaming	⇑
Football	⇑
Moaned at	⇑
Special Occasion	⇑
Our Days	⇑
Rehearsals	⇑
Gym	⇑
Wine Tasting	⇑
Hangover	⇑
Travel	⇑
Updates	⇑
Special Event	⇑
Boasting	⇑
Health	⇑
Going Out	⇑
Work	Work/Jobs
This Study	⇑
Job Hunting	⇑
Relational Ping	Relational Communication
Emotional Ping	⇑
Silliness	⇑
Relational Stuff	⇑
Funny Ping	⇑
Silly Ping	⇑
The Relationship	⇑
Being Silly	⇑
Sweetness	⇑
Effortful Ping	⇑
Connecting Ping	⇑
Being Together	Being Together
Visiting Each Other	Plans for Visiting

	Each Other
Organising	⇑
Plans	⇑
Being Involved	⇑
Ping	Ping
Wake Up	⇑
n/a	n/a

Table H.7: Coding of Conversation Topics

H.2 Feelings Coding

First Set	**Second Set**	**Third Set**
Happy	Happy	Happy
Good	⇑	
Liked	⇑	
Nice	⇑	
Glad	⇑	
Very Happy	⇑	
Really Good	⇑	
Liked	⇑	
Amazed	⇑	
Fun	Fun/Amused	Fun/Amused
Amused	⇑	
Entertained	⇑	
Cheeky	⇑	
Cheesy	⇑	
Playful	⇑	
n/a	n/a	n/a
Better	Better	Better
Moan	⇑	
Rant	⇑	
Back to Normal	⇑	
Okay	⇑	
Normal	⇑	
Much Better	⇑	
Excited	Excited	Excited
Cared For	Cared For	Cared For
Reassured	⇑	
Appreciated	⇑	
Helped	⇑	

Wanted	⇑	
Thanked	⇑	
Reciprocated	⇑	
Anticipation	⇑	
Glad to help	⇑	
Being thought about	⇑	
Valued	⇑	
Connected	⇑	
Involved	⇑	
Apologise	⇑	
Effortful	⇑	
Sweet	⇑	
Seeing Each Other	Seeing Each Other	Seeing Each Other
Seeing them soon	⇑	
Visiting	⇑	
Being Together	⇑	
Missing Each Other	Missing Each Other	Missing Each Other
Confused	Confused	[removed]
Bemused	⇑	
Sad	Sad	Upset/Guilty
Bad	⇑	
Disappointed	⇑	
Upset	⇑	
Guilty	Guilty/Unappreciated	⇑
Taken for Granted	⇑	
Annoyed	Annoyed	Annoyed
Frustrated	⇑	

Table H.8: Coding of Feeling Topics

H.3 Appreciation Coding

First Set	**Second Set**	**Third Set**
Being Involved	Being Involved/ Together	Being Involved/ Together
Met His Friends	⇑	
Interested	⇑	
Coming to visit	⇑	
Visiting Family	⇑	
Liked my ideas	⇑	
Being blamed	⇑	
Meeting up	⇑	

Changed plans to be together	⇑	
Being together	⇑	
Knowledgeable about partner	⇑	
Non-important messages	⇑	
Talking Properly	Proper Conversation	⇑
Talking	⇑	
Finding Time	Taking the Time/ Effortful	Taking the Time/ Effortful
Taking Time	⇑	
Beat boredom	⇑	
Took the Time	⇑	
Appreciation of Effort	⇑	
Making an Effort	⇑	
Effortful	⇑	
Initiation of Contact	Initiation of Contact	⇑
Thoughtful	Thoughtful	Thoughtful
Being thought of	⇑	
Sweet gesture	⇑	
Being thought about	⇑	
Fun	Fun	⇑
Doing interesting things	⇑	
Unimportant	Unimportant	Unimportant
Disappointed	⇑	
Forgot	⇑	
Taken for granted	⇑	
Ignored	⇑	
Cared For/ Supported	Cared For/ Supported	Cared For/ Supported
Nice	⇑	
Liked	⇑	
Concerned	⇑	
There for me	⇑	
Being there	⇑	
Thanked	⇑	
Being sweet	⇑	
Listened to	⇑	
Helped	⇑	
Supported	⇑	
Kept Company	⇑	
Wanted	Wanted	⇑
Anticipation	Anticipation	Anticipation
Looking forward to seeing each other	⇑	⇑ ⇑
Surprised	⇑	⇑
Being Missed	Being Missed	Being Missed
Complained to	Moaned At	Moaned At

Relational Repair	⇑	

Table H.9: Coding of Appreciation Topics

H.4 Crosstabulations of Feelings, Conversation Topic, Appreciation and Communication Media

Communication Media	Feelings										
	Happy	**Fun/ Amused**	**Better**	**Excited**	**Cared For**	**Seeing each other**	**Missing each other**	**n/a**	**Upset/ Guilty**	**Annoyed**	**Total**
Face to Face	0	0	0	0	0	14	0	0	0	0	14
SMS	6	2	2	0	0	2	1	6	1	2	22
Telephone	12	3	2	3	0	1	1	5	5	3	35
Skype (voice only)	1	0	0	0	0	0	0	0	0	0	1
Skype (with video)	0	0	1	1	0	0	0	0	0	2	4
doodleMessenger	3	5	0	0	1	0	1	2	0	1	13
whatsapp	4	2	0	0	2	0	1	3	1	0	13
Total	26	12	5	4	3	17	4	16	7	8	102

Table H.10: Crosstabulation of pA's data showing Feelings against Communication Media

Communication Media	Feelings										
	Happy	**Fun/ Amused**	**Better**	**Excited**	**Cared For**	**Seeing each other**	**Missing each other**	**n/a**	**Upset/ Guilty**	**Annoyed**	**Total**
Face to Face	1	0	0	0	0	12	0	0	0	0	13
IM	8	2	0	0	0	0	1	1	0	1	13
SMS	4	2	1	5	3	0	3	2	1	2	23
Telephone	11	3	6	3	0	0	4	4	2	1	34
Skype (with video)	3	0	0	0	1	0	0	0	0	0	4
doodleMessenger	1	10	0	1	1	0	0	0	0	0	13
Total	28	17	7	9	5	12	8	7	3	4	100

Table H.11: Crosstabulation of pB's data showing Feelings against Communication Media

Communication Media	Conversation Topics							
	Chit-Chat/ Our Days	**Work/ Jobs**	**Relational Communciation**	**Being Together**	**Plans for visiting each other**	**Ping**	**n/a**	**Total**
Face to Face	1	1	0	12	0	0	0	14
SMS	10	4	0	0	6	1	1	22
Telephone	16	8	1	0	6	0	4	35
Skype (voice only)	0	1	0	0	0	0	0	1
Skype (with video)	2	1	0	0	1	0	0	4
doodleMessenger	0	0	11	0	1	1	0	13
whatsapp	5	1	4	0	0	3	0	13
Total	34	16	16	12	14	5	5	102

Table H.12: Crosstabulation of pA's data showing Conversation Topics against Communication Media

Communication Media	Conversation Topics							
	Chit-Chat/ Our Days	**Work/ Jobs**	**Relational Communciation**	**Being Together**	**Plans for visiting each other**	**Ping**	**n/a**	**Total**
Face to Face	1	1	0	11	0	0	0	13
IM	4	0	4	0	1	4	0	13
SMS	8	3	4	1	5	1	1	23
Telephone	11	8	1	0	5	4	5	34
Skype (with video)	2	2	0	0	0	0	0	4
doodleMessenger	0	0	13	0	0	0	0	13
Total	26	14	22	12	11	9	6	100

Table H.13: Crosstabulation of pB's data showing Conversation Topics against Communication Media

Conversation Topic	Feelings										
	Happy	**Fun/ Amused**	**Better**	**Excited**	**Cared For**	**Seeing each other**	**Missing each other**	**n/a**	**Upset/ Guilty**	**Annoyed**	**Total**
Chit-Chat/ Our Days	10	3	3	2	0	1	1	6	4	4	34
Work/Jobs	4	1	1	0	0	2	1	2	2	3	16
Relational Communication	4	5	0	0	2	0	1	3	0	1	16
Being Together	0	0	0	0	0	12	0	0	0	0	12
Plans for visiting each other	6	1	1	2	0	2	1	1	0	0	14
Ping	2	1	0	0	1	0	0	0	1	0	5
n/a	0	1	0	0	0	0	0	4	0	0	5
Total	26	12	5	4	3	17	4	16	7	8	102

Table H.14: Crosstabulation of pA's data showing Conversation Topics against Feelings

Conversation Topic	Feelings										
	Happy	**Fun/ Amused**	**Better**	**Excited**	**Cared For**	**Seeing each other**	**Missing each other**	**n/a**	**Upset/ Guilty**	**Annoyed**	**Total**
Chit-Chat/ Our Days	12	3	0	3	0	1	4	0	1	2	26
Work/Jobs	2	0	4	1	3	1	1	1	0	1	14
Relational Communication	6	10	1	1	2	0	0	1	1	0	22
Being Together	1	0	0	0	0	10	1	0	0	0	12
Plans for visiting each other	3	1	1	4	0	0	0	1	0	1	11
Ping	4	0	1	0	0	0	2	1	1	0	9
n/a	0	3	0	0	0	0	0	3	0	0	6
Total	28	17	7	9	5	12	8	7	3	4	100

Table H.15: Crosstabulation of pB's data showing Conversation Topics against Feelings

Feelings	**Appreciation**						
	Yes with Reason	**Ish with Reason**	**Ish**	**Neutral**	**No**	**No with Reason**	**Total**
Happy	18	2	0	6	0	0	26
Fun/Amused	2	3	2	5	0	0	12
Better	3	0	0	2	0	0	5
Excited	1	0	0	3	0	0	4
Cared For	3	0	0	0	0	0	3
Seeing each other	16	0	0	1	0	0	17
Missing each other	1	1	0	2	0	0	4
n/a	1	2	1	10	1	1	16
Upset/Guilty	3	1	0	3	0	0	7
Annoyed	0	1	1	3	1	2	8
Total	48	10	4	35	2	3	102

Table H.16: Crosstabulation of pA's data showing Appreciation against Feelings

Feelings	Appreciation				
	Yes with Reason	**Yes**	**Neutral**	**No with Reason**	**Total**
Happy	17	0	10	1	28
Fun/Amused	9	1	7	0	17
Better	5	1	1	0	7
Excited	6	1	2	0	9
Cared For	5	0	0	0	5
Seeing each other	11	1	0	0	12
Missing each other	5	1	2	0	8
n/a	2	0	5	0	7
Upset/Guilty	1	0	2	0	3
Annoyed	0	0	3	1	4
Total	61	5	32	2	100

Table H.17: Crosstabulation of pB's data showing Appreciation against Feelings

Conversation Topic	Appreciation						
	Yes with Reason	**Ish with Reason**	**Ish**	**Neutral**	**No**	**No with Reason**	**Total**
Chit-Chat/Our Days	10	5	1	17	1	0	34
Work/Jobs	7	0	3	4	0	2	16
Relational Communication	7	3	0	4	1	1	16
Being Together	11	0	0	1	0	0	12
Plans for visiting each other	8	1	0	5	0	0	14
Ping	4	1	0	0	0	0	5
n/a	1	0	0	4	0	0	5
Total	48	10	4	35	2	3	102

Table H.18: Crosstabulation of pA's data showing Appreciation against Conversation Topics

Conversation Topic	Appreciation				
	Yes with Reason	**Yes**	**Neutral**	**No with Reason**	**Total**
Chit-Chat/Our Days	16	1	8	1	26
Work/Jobs	10	1	2	1	14
Relational Communication	10	1	11	0	22
Being Together	10	2	0	0	12
Plans for visiting each other	7	0	4	0	11
Ping	7	0	2	0	9
n/a	1	0	5	0	6
Total	61	5	32	2	100

Table H.19: Crosstabulation of pB's data showing Appreciation against Conversation Topics

Communication Media	Appreciation						
	Yes with Reason	**Ish with Reason**	**Ish**	**Neutral**	**No**	**No with Reason**	**Total**
Face to Face	13	0	0	1	0	0	14
SMS	6	3	2	11	0	0	22
Telephone	16	2	1	15	0	1	35
Skype (voice only)	1	0	0	0	0	0	1
Skype (with video)	1	1	0	1	0	1	4
doodleMessenger	4	2	0	5	1	1	13
whatsapp	7	2	1	2	1	0	13
Total	48	10	4	35	2	3	102

Table H.20: Crosstabulation of pA's data showing Appreciation against Communication Media

Communication Media	Appreciation				
	Yes with Reason	**Yes**	**Neutral**	**No with Reason**	**Total**
Face to Face	12	1	0	0	13
IM	8	0	5	0	13
SMS	14	1	8	0	23
Telephone	18	2	12	2	34
Skype (with video)	3	0	1	0	4
doodleMessenger	6	1	6	0	13
Total	61	5	32	2	100

Table H.21: Crosstabulation of pB's data showing Appreciation against Communication Media

Appendix I

HotHugs Supporting Material

In addition to the SP scales, the contact diary asked for three other pieces of information – what they talked/wrote about, how it made them feel and why and also whether (and why) the exchange made them feel appreciated.

This data was independently coded by two coders. The topics of conversation were found to consist of:

- Relationships
- Our Days/Catch-Up/Chit-chat
- Work
- Being Together

An inter-rater reliability analysis using the Kappa statistic was performed to determine consistency among raters (Kappa = 0.383 ($p < 0.001$)).

There were a substantial number of feelings that were discussed, more than we anticipated given the granularity of the conversation topics. The ten key emotions were:

- Happy/Good
- Sad
- Amazing
- Cared About
- Neutral
- Closer
- Disconnected
- Missed
- Excited
- Annoying

An inter-rater reliability analysis using the Kappa statistic was performed to determine consistency among raters (Kappa = 0.438 ($p < 0.001$)).

Appreciation had a very clear breakdown of answers:

- Yes
- Yes (with a reason)
- Neutral
- No
- No (with a reason)

An inter-rater reliability analysis using the Kappa statistic was performed to determine consistency among raters (Kappa = 0.855 ($p < 0.001$)).

The appreciation reasons had a less clear break-down but the eight which were selected for further analysis were:

- Involved
- Cared For
- Loved
- Missed
- Hugged
- Being Together
- Anticipate Being Together

An inter-rater reliability analysis using the Kappa statistic was performed to determine consistency among raters (Kappa = 0.668 ($p < 0.001$)).

Sections I.1 through I.3 describe the progression of the coding themes.

The coding of these three facets of communication is not that interesting in of itself. What we want to know is how/if the three facets are connected, whether they are connected to the use of a particular communication media and what their impact on feelings of Social Presence are.

The correct test to perform in these circumstances would be to run a Chi Square test for correlation between each of the three facets. Unfortunately, the size of the data compared to the number of categories means that such a test cannot be performed correctly.

Instead, Section I.4 shows the raw data of the crosstabulations between the three facets.

Looking at the data, there appears to be a general bias towards using Skype (with Video) but there is no clear distinction across conversation topic, appreciation or emotion by communication media. Similarly, most conversations are biased towards "Our Days/Chit-Chat" but show no clear distinction across communication media, appreciation or emotion. There appears to be no association between appreciation and feelings.

There appears to be a weak association between conversation topics and feelings. 'Being Together' was associated with being cared about, feeling both closer and amazing.

We can't determine whether this is a causal link; all we can determine is that there appears to a weak association between the three categories. As the data does not meet the assumptions for running either a Chi Square test or a Linear Regression we can make no more claims about the association.

The reason for investigating this association is that the three facets show some indication of having an impact of feelings of SP. Tables I.1 and I.2 show the results of performing a Kruskall-Wallis test on each of the facets against SP and Closeness. Tables I.3 through I.6 presents the Mean Rank results for each of these tests.

In each case (whether significant or not), the results match what you might expect. In terms of appreciation, there is a decrease in SP from communication acts where the responder felt appreciated to those where they did not. The reasons for feeling appreciated are also unsurprising; Being Together was associated with the highest levels of SP with Hugged and Cared for also ranked highly whereas negative reasons (feeling missed) were associated with the lowest levels of SP.

The conversation topics were divided by those which might be termed 'Emotional' (i.e. 'Being Together', 'Relationships') which were associated with higher levels of SP as compared to those topics which were more routine (i.e. 'Work' and 'Our Days/Chit-Chat').

The Feelings categories again match expectations; 'Cared About', 'Closer', 'Happy/Good' and 'Excited' are all ranked highly in terms of Social Presence whereas 'Disconnected', 'Missed' and 'Sad' are all associated with low levels of SP/Closeness.

These statistics suggest that all three facets have an impact on SP . However, the association between them (and conversation media) indicates that the true cause of impact on SP is likely to be some combination of the four factors. Again, without a Linear Regression it is impossible to determine which factor is actually having an impact on the participants' feelings of Social Presence.

This finding relates to the claims we made in Chapters 2 and 4 regarding our definition of SP. As a concept, SP is not only determined by the communication medium being used and the impact of the particular medium is also dependent on how it is used.

Topic	**n**	**Test Statistic**	**p**	**Significant?**
Conversation	80	$H(3) = 22.604$	$p < 0.001$	**Yes**
Feeling	80	$H(7) = 37.953$	$p < 0.001$	**Yes**
Appreciation	80	$H(3) = 62.572$	$p < 0.001$	**Yes**
Appreciation Reason	55	$H(6) = 20.690$	$p = 0.002$	**Yes**

Table I.1: Kruskall-Wallis results for Conversation Topic, Feeling, Appreciation by pLu's SP scores

Topic	**n**	**Test Statistic**	**p**	**Significant?**
Conversation	76	$H(3) = 14.766$	$p = 0.002$	**Yes**
Feeling	76	$H(8) = 45.340$	$p < 0.001$	**Yes**
Appreciation	76	$H(4) = 47.535$	$p < 0.001$	**Yes**
Appreciation Reason	36	$H(5) = 4.899$	$p = 0.428$	No

Table I.2: Kruskall-Wallis results for Conversation Topic, Feeling, Appreciation by pAl's SP scores

Topic	pLu			pAl		
	n	Topic	Mean Rank SP	n	Topic	Mean Rank SP
Conversation	7	Relationships	131.50	7	Relationships	110.86
	63	Our Days/ Chit-Chat	84.07	50	Our Days/ Chit-Chat	79.14
	8	Work	81.58	17	Work	102.56
	2	Being Together	171.50	2	Being Together	165.50

Table I.3: Mean Ranks for SP Scores for each Participant by Conversation Topic

Topic	pLu			pAl		
	n	Topic	Mean Rank SP	n	Topic	Mean Rank SP
Feelings	29	Happy/Good	92.82	48	Happy/Good	85.16
	9	Sad	75.50	6	Sad	93.41
	-	Amazing	-	6	Amazing	126.60
	20	Cared About	109.33	6	Cared About	128.35
	7	Neutral	40.21	2	Neutral	20.00
	7	Closer	124.31	2	Closer	103.70
	1	Disconnected	34.00	1	Disconnected	42.50
	2	Missed	78.50	4	Missed	136.00
	5	Excited	98.91	-	Excited	-
	-	Annoying	-	1	Annoying	11.00

Table I.4: Mean Ranks for SP Scores for each Participant by Feeling

Topic	pLu			pAl		
	n	Topic	Mean Rank SP	n	Topic	Mean Rank SP
Appreciation	4	Yes	86.63	10	Yes	131.30
	55	Yes (With a reason)	112.60	35	Yes (With a reason)	112.00
	19	Neutral	45.92	29	Neutral	71.24
	2	No	95.00	1	No	42.50
	-	No (With a reason)	-	1	No (With a reason)	11.00

Table I.5: Mean Ranks for SP Scores for each Participant by Appreciation

Topic	pLu			pAl		
	n	Topic	Mean Rank SP	n	Topic	Mean Rank SP
Appreciation Reason	3	Involved	45.50	4	Involved	28.50
	19	Caring For	61.03	7	Caring For	43.93
	6	Loved	58.17	6	Loved	30.80
	19	Missed	41.45	12	Missed	40.67
	1	Hugged	83.50	2	Hugged	39.50
	2	Being Together	102.50	-	Being Together	-
	5	Anticipate Being Together	66.30	5	Anticipate Being Together	41.10

Table I.6: Mean Ranks for SP Scores for each Participant by Appreciation Reason

I.1 Conversation Coding

First Set	Second Set
Chit-Chat	Our Days/Catch-up/Chit-Chat
Family	⇑
Beliefs	⇑
Our Days	⇑
Catch-up	⇑
My day	⇑
Relationships	Relationships
The Future	⇑
Missing each other	⇑
Being Involved	⇑
Work	Work
The study	⇑
Being Together	Being Together

Table I.7: Coding of Conversation Topics

I.2 Feelings Coding

First Set	Second Set	Third Set
Happy	Happy	Happy/Good
Better	⇑	
Pleased	⇑	
Cheered up	⇑	
Enjoyed	⇑	
Positive	⇑	
Brightened up	⇑	
Engaged	⇑	
Nice	⇑	
Lucky	⇑	
Nice	⇑	
Glad	⇑	
Good	Good	⇑
Really good	⇑	
Fine	⇑	
Relaxed	Relaxed	⇑
Amused	Amused	⇑
Sad	Sad	Sad
Stressed	⇑	
Worried	⇑	
Lonely	⇑	
Upset	⇑	
Amazing	Amazing	Amazing
Brilliant	⇑	
Really positive	⇑	
Cared about	Cared about	Cared about
Reassured	⇑	
Trusted	⇑	
Comforted	⇑	
Connected	⇑	
Secure	⇑	
Involved	⇑	
Sharing	Sharing	⇑
Understanding	Understanding	⇑
Loved	Loved	⇑
Open	⇑	⇑
Neutral	Neutral	Neutral
Closer	Closer	Closer
Connected	Connected	⇑
Disconnected	Disconnected	Disconnected
Unconnected	Unconnected	⇑
Missed	Missed	Missed
Excited	Excited	Excited
Annoyed	Annoyed	Annoyed
Insecure	Insecure	⇑
Tired	**Removed**	
Unworried	**Removed**	
Reflective	**Removed**	

Table I.8: Coding of Emotional Topics

I.3 Appreciation Coding

First Set	Second Set
Involved	Involved
Thinking about partner	⇑
Chatted	⇑
Interested	⇑
Engaged	⇑
Cheered-up	⇑
Improved his day	⇑
Cared For	Cared For
Effort	⇑
Reassurance	⇑
Connected	⇑
Concern	⇑
Supported	⇑
Listened to	⇑
Worried about	⇑
Complimented	⇑
Reassurance	⇑
Said nice things	⇑
Loved	Loved
Missed	Missed
Hugged	Hugged
Being Together	Being Together
Anticipate being together	Anticipate being together

Table I.9: Coding of Appreciation Topics

I.4 Crosstabulations of Feelings, Conversation Topic, Appreciation and Communication Media

Feelings	Communication Media						Total
	Face to Face	IM	SMS	Telephone	Skype (with video)	hotHugs	
Happy/Good	0	0	19	1	5	4	29
Sad	0	1	8	0	0	0	9
Cared About	1	0	12	1	3	3	20
Neutral	0	0	7	0	0	0	7
Closer	1	0	0	2	4	0	7
Disconnected	0	0	0	0	1	0	1
Missed	0	0	2	0	0	0	2
Excited	0	0	4	0	1	0	5
Total	2	1	52	4	14	7	80

Table I.10: Crosstabulation of pLu's data showing Feelings against Communication Media

Feelings	Communication Media						Total
	Face to Face	IM	SMS	Telephone	Skype (with video)	hotHugs	
Happy/Good	0	2	29	3	11	3	48
Sad	0	0	6	0	0	0	6
Amazing	2	0	3	0	1	0	6
Cared About	0	0	4	0	1	1	6
Neutral	0	0	2	0	0	0	2
Closer	0	0	0	1	0	1	2
Disconnected	0	0	1	0	0	0	1
Missed	0	0	3	0	0	1	4
Annoying	0	0	1	0	0	0	1
Total	2	2	49	4	13	6	76

Table I.11: Crosstabulation of pAl's data showing Feelings against Communication Media

Conversation Topics	Communication Media						Total
	Face to Face	IM	SMS	Telephone	Skype (with Video)	hotHugs	
Relationships	0	1	0	1	3	2	7
Our Days/Chit-Chat	0	0	45	3	10	5	63
Work	0	0	7	0	1	0	8
Being Together	2	0	0	0	0	0	2
Total	2	1	52	4	14	7	80

Table I.12: Crosstabulation of pLu's data showing Conversation Topic against Communication Media

Conversation Topics	**Communication Media**						**Total**
	Face to Face	**IM**	**SMS**	**Telephone**	**Skype (with Video)**	**hotHugs**	
Relationships	0	0	4	2	1	0	7
Our Days/Chit-Chat	0	1	33	2	8	6	50
Work	0	1	12	0	4	0	17
Being Together	2	0	0	0	0	0	2
Total	2	2	49	4	13	6	76

Table I.13: Crosstabulation of pAl's data showing Conversation Topic against Communication Media

Feelings	**Conversation Topic**				
	Relationships	**Our Days/ Chit-Chat**	**Work**	**Being Together**	**Total**
Happy/Good	1	28	0	0	29
Sad	1	6	2	0	9
Cared About	3	12	4	1	20
Neutral	0	6	1	0	7
Closer	2	4	0	1	7
Disconnected	0	1	0	0	1
Missed	0	2	0	0	2
Excited	0	4	1	0	5
Total	7	63	8	2	80

Table I.14: Crosstabulation of pLu's data showing Feelings against Conversation Topic

Feelings	**Conversation Topic**				
	Relationships	**Our Days/ Chit-Chat**	**Work**	**Being Together**	**Total**
Happy/Good	4	33	11	0	48
Sad	1	4	1	0	6
Amazing	0	2	2	2	6
Cared About	1	3	2	0	6
Neutral	0	1	1	0	2
Closer	0	2	0	0	2
Disconnected	0	1	0	0	1
Missed	1	3	0	0	4
Annoying	0	1	0	0	1
Total	7	50	17	2	76

Table I.15: Crosstabulation of pAl's data showing Feelings against Conversation Topic

Feelings	**Appreciation**				**Total**
	Yes	**Yes (with a Reason)**	**Neutral**	**No**	
Happy/Good	2	20	7	0	29
Sad	0	6	2	1	9
Cared About	2	17	1	0	20
Neutral	0	0	7	0	7
Closer	0	6	0	1	7
Disconnected	0	0	1	0	1
Missed	0	2	0	0	2
Excited	0	4	1	0	5
Total	4	55	19	2	80

Table I.16: Crosstabulation of pLu's data showing Feelings against Appreciation

Feelings	**Appreciation**					**Total**
	Yes	**Yes (with a Reason)**	**Neutral**	**No**	**No (with a Reason)**	
Happy/Good	5	22	20	1	0	48
Sad	0	2	4	0	0	6
Amazing	3	2	1	0	0	6
Cared About	2	4	0	0	0	6
Neutral	0	0	2	0	0	2
Closer	0	1	1	0	0	2
Disconnected	0	0	1	0	0	1
Missed	0	4	0	0	0	4
Annoying	0	0	0	0	1	1
Total	10	35	29	1	1	76

Table I.17: Crosstabulation of pAl's data showing Feelings against Appreciation

Appreciation	**Conversation Topic**				
	Relationships	**Our Days/ Chit-Chat**	**Work**	**Being Together**	**Total**
Yes	0	3	1	0	4
Yes (with a reason)	6	43	4	2	55
Neutral	0	17	2	0	19
No	1	0	1	0	2
Total	7	63	8	2	80

Table I.18: Crosstabulation of pLu's data showing Appreciation against Conversation Topic

Appreciation	**Conversation Topic**				
	Relationships	**Our Days/ Chit-Chat**	**Work**	**Being Together**	**Total**
Yes	1	7	0	2	10
Yes (with a reason)	5	23	7	0	35
Neutral	1	18	10	0	29
No	0	1	0	0	1
No (with a reason)	0	1	0	0	1
Total	7	50	17	2	76

Table I.19: Crosstabulation of pAl's data showing Appreciation against Conversation Topic

Appreciation	**Communication Media**						**Total**
	Face to Face	**IM**	**SMS**	**Telephone**	**Skype (with Video)**	**hotHugs**	
Yes	0	0	3	0	0	1	4
Yes (with a reason)	2	1	30	4	12	6	55
Neutral	0	0	18	0	1	0	19
No	0	0	1	0	1	0	2
Total	2	1	52	4	14	7	80

Table I.20: Crosstabulation of pLu's data showing Appreciation against Communication Media

Appreciation	**Communication Media**						**Total**
	Face to Face	**IM**	**SMS**	**Telephone**	**Skype (with Video)**	**hotHugs**	
Yes	2	0	3	2	1	2	10
Yes (with a reason)	0	1	21	1	8	4	35
Neutral	0	0	24	1	4	0	29
No	0	1	0	0	0	0	1
No (with a reason)	0	0	1	0	0	0	1
Total	2	2	49	4	13	6	76

Table I.21: Crosstabulation of pAl's data showing Appreciation against Communication Media

Appendix J

Magic Sock Drawer Supporting Material

In addition to the SP scales, the contact diary asked for three other pieces of information – what they talked/wrote about, how it made them feel and why and also whether (and why) the exchange made them feel appreciated.

This data was independently coded by two coders. The topics of conversation were found to consist of:

- Being Together
- Information Exchange
- Ping
- Catch-up/Chatting
- Coming to visit
- Work
- Shared Experiences

There were a substantial number of feelings that were discussed, more than we anticipated given the granularity of the conversation topics. The six key emotions were:

- Happy
- Connected
- Sad
- Annoyed
- Busy
- n/a

Appreciation had a very clear breakdown of answers:

- Yes (with a reason)
- n/a
- Neither yes or no

The only reason expressed for appreciation was 'Cared For'.

Sections J.1 through J.3 describe the progression of the coding themes.

The coding of these three facets of communication is not that interesting in of itself. What we want to know is how/if the three facets are connected, whether they are connected to the use of a particular communication media and what their impact on feelings of Social Presence are.

The correct test to perform in these circumstances would be to run a Chi Square test for correlation between each of the three facets. Unfortunately, the size of the data compared to the number of categories means that such a test cannot be performed correctly.

Instead, Section J.4 shows the raw data of the crosstabulations between the three facets.

Looking at the data, there appears to be no association between communication media and conversation topic, appreciation or emotion. Although most conversations are biased towards "Catch-up/Chatting" the crosstabulaitons show no clear association across communication media, appreciation or emotion. There also appears to be no association between appreciation and feelings.

There does appears to be a weak association between conversation topics and feelings. Positive feelings of 'Happy' and 'Connected' were associated with 'being together' or talking about 'shared experiences'. Negative feelings (such as 'Sad', 'Annoyed' and 'Busy') were associated with talking about 'work' or 'information exchange'.

We can't determine whether this is a causal link; all we can determine is that there could be an association between the three categories. As the data does not meet the assumptions for running either a Chi Square test or a Linear Regression we can make no more claims about the association.

The reason for investigating this association is that the three facets show some indication of having an impact of feelings of SP. Table J.1 shows the results of performing a Kruskall-Wallis test on each of the facets against Social Presence. Tables J.2 through J.4 presents the Mean Rank results for each of these tests.

In each case the test is not significant. That said, the result order still matches what you might expect. In terms of appreciation, there is a decrease in SP from communication acts where the responder felt appreciated to those where they did not.

The conversation topics were divided by those which might be termed 'Emotional' (i.e. 'Being Together' and 'Shared Experiences') which were associated with higher levels of SP as compared to those topics which were more routine (i.e. 'Information Exchange' and 'Work'). The other conversation topics were associated with middling levels of SP.

The Feelings categories again match expectations; 'Happy' and 'Connected' are ranked highly whereas 'Annoyed' and 'Busy' are associated with low levels of Social Presence.

These statistics suggest that none of the three facets have an impact on Social Presence scores. This is in stark contrast to the findings of our other four case studies. Given the paucity of the data, this is perhaps unsurprising.

Topic	n	Test Statistic	p	Significant?
Conversation	81	H(6) = 9.513	p = 0.147	No
Feeling	81	H(5) = 4.388	p = 0.495	No
Appreciation	81	H(2) = 00.509	p = 0.775	No

Table J.1: Kruskall-Wallis results for Conversation Topic, Feeling, Appreciation by pC's SP scores

Topic	pC		
	n	Topic	Mean Rank SP
Conversation	2	Being Together	75.25
	3	Information Exchange	21.33
	10	Ping	49.85
	42	Catch-up/ Chatting	39.21
	5	Coming to visit	34.70
	16	Work	39.00
	3	Shared Experiences	54.50

Table J.2: Mean Ranks for SP Scores for pC by Conversation Topic

Topic	pC		
	n	Topic	Mean Rank SP
Feelings	4	Happy	45.50
	3	Connected	53.50
	2	Sad	44.00
	2	Annoyed	28.25
	1	Busy	2.00
	69	n/a	41.04

Table J.3: Mean Ranks for SP Scores for pC by Feeling

Topic	pC		
	n	Topic	Mean Rank SP
Appreciation	11	Yes (with a reason)	41.82
	66	n/a	41.36
	4	Neither yes or no	32.88

Table J.4: Mean Ranks for SP Scores for pC by Appreciation

J.1 Conversation Coding

First Set	Second Set
Being Together	Being Together
Information Exchange	Information Exchange
Ping	Ping
Emotional Ping	⇑
Catch-up	Catch-up/Chatting
Chatting	⇑
Holiday	⇑
Issues	⇑
Housemates	⇑
Gaming	⇑
Family	⇑
Hobby	⇑
Coming to visit	Coming to visit
Leaving each other	⇑
Work	Work
Shared Experiences	Shared Experiences
Presents	⇑
Special Occasions	⇑

Table J.5: Coding of Conversation Topics

J.2 Feelings Coding

First Set	Second Set
Happy	Happy
Laugh	⇑
Glad	⇑
Relaxed	⇑
Fun	⇑
Connected	Connected
Not alone	⇑
Sad	Sad
Annoyed	Annoyed
Busy	Busy
n/a	n/a

Table J.6: Coding of Emotional Topics

J.3 Appreciation Coding

First Set	**Second Set**
Cared For	Cared For
Connected	⇑
In touch	⇑
Wanted	⇑
Show an interest	⇑
Supported	⇑

Table J.7: Coding of Appreciation Topics

J.4 Crosstabulations of Feelings, Conversation Topic, Appreciation and Communication Media

Feelings	Communication Media											Total
	Face to Face	**IM**	**SMS phone**	**Tele-**	**Skype (voice only)**	**Skype (with video)**	**MSD**	**Spotify**	**MMS**	**Face-book**	**Whats-app**	
Happy	0	0	1	2	0	0	0	1	0	0	0	4
Connected	1	0	1	1	0	0	0	0	0	0	0	3
Sad	0	0	2	0	0	0	0	0	0	0	0	2
Annoyed	0	0	1	0	0	0	1	0	0	0	0	2
Busy	0	1	0	0	0	0	0	0	0	0	0	1
n/a	1	5	23	16	1	15	2	1	1	1	3	69
Total	2	6	28	19	1	15	3	2	1	1	3	81

Table J.8: Crosstabulation of pC's data showing Feelings against Communication Media

Conversation Topics	Communication Media											Total
	Face to Face	IM	SMS	Telephone	Skype (voice only)	Skype (with video)	MSD	Spotify	MMS	Facebook	Whatsapp	
Being Together	2	0	0	0	0	0	0	0	0	0	0	2
Information Exchange	0	0	1	1	0	0	1	0	0	0	0	3
Ping	0	0	4	2	0	0	1	1	1	0	1	10
Catch-up/ Chatting	0	5	15	8	0	9	1	1	0	1	2	42
Coming to visit	0	0	2	2	0	1	0	0	0	0	0	5
Work	0	1	5	6	1	3	0	0	0	0	0	16
Shared Experiences	0	0	1	0	0	2	0	0	0	0	0	3
Total	2	6	28	19	1	15	3	2	1	1	3	81

Table J.9: Crosstabulation of pC's data showing Conversation Topic against Communication Media

Feelings	Conversation Topic							Total
	Being Together	Information Exchange	Ping	Catch-up/ Chatting	Coming to visit	Work	Shared Experiences	
Happy	0	1	1	1	0	0	1	4
Connected	1	0	1	0	0	1	0	3
Sad	0	0	0	2	0	0	0	2
Annoyed	0	1	0	0	0	1	0	2
Busy	0	0	0	1	0	0	0	1
n/a	1	1	8	38	5	14	2	69
Total	2	3	10	42	5	16	3	81

Table J.10: Crosstabulation of pC's data showing Feelings against Conversation Topic

Feelings	**Appreciation**			**Total**
	Yes with a reason	**n/a**	**Neither yes or no**	
Happy	1	2	1	4
Connected	2	0	1	3
Sad	1	1	0	2
Annoyed	0	2	0	2
Busy	0	1	0	1
n/a	7	60	2	69
Total	11	66	4	81

Table J.11: Crosstabulation of pC's data showing Feelings against Appreciation

Appreciation	**Conversation Topic**							
	Being Together	**Information Exchange**	**Ping**	**Catch-up/ Chatting**	**Coming to visit**	**Work**	**Shared Experiences**	**Total**
Yes (with a reason)	1	1	0	2	2	5	0	11
n/a	1	2	9	37	3	11	3	66
Neither yes or no	0	0	1	3	0	0	0	4
Total	2	3	10	42	5	16	3	81

Table J.12: Crosstabulation of pC's data showing Appreciation against Conversation Topic

Appreciation	Communication Media											Total
	Face to Face	**IM**	**SMS**	**Telephone**	**Skype (voice only)**	**Skype (with video)**	**MSD**	**Spotify**	**MMS**	**Facebook**	**Whatsapp**	
Yes (with a reason)	1	0	3	6	0	1	0	0	0	0	0	11
n/a	1	6	23	13	1	13	3	1	1	1	3	66
Neither yes or no	0	0	2	0	0	1	0	1	0	0	0	4
Total	2	6	28	19	1	15	3	2	1	1	3	81

Table J.13: Crosstabulation of pC's data showing Appreciation against Communication Media